




*Digi International Inc.*

# AccelePort T1 Modem Bank

## Installation and Configuration Guide

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# Regulatory Statements

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## Federal Communications Commission (FCC) Statement

### Radio Frequency Interference (RFI)

This equipment generates and uses radio frequency energy, and if not installed and used in strict accordance with manufacturer's instructions, may cause interference to radio and television reception. This equipment has been type-tested to verify that it complies with the limits for a Class A computing device in accordance with specifications in Subpart J of Part 15 of FCC Rules (Appendix B of OST Bulletin No. 62), which are designed to provide reasonable protection against such interference in a residential installation. However, this does not assure that such interference will not occur in a particular installation. If this equipment does cause interference to radio or television reception, which can be determined by turning your computer OFF and ON, the user is encouraged to attempt correction of the interference by one or more of the following measures:

1. Reorient the receiving antenna.
2. Relocate your computer with respect to the receiver.
3. Move your computer away from the receiver.
4. Plug your computer into a different outlet so the computer and receiver are not on the same circuit.

If these measures fail to eliminate the interference, the user should contact either the distributor or an experienced radio/television technician for further suggestions. The user may also find the following booklet (prepared by the FCC) helpful:

"How to Identify and Resolve Radio/TV Interference Problems"

This booklet is available from the U.S. Government Printing Office, Washington, DC. Request should be made for Stock No. 004000003454.



# FCC Part 68

**FCC Registration: 5TLUSA-23932-DD-N**

**Ringer Equivalence Number: 0.0B**

This T1 Modem Bank complies with Part 68 of FCC Rules. On the back of the T1 Modem Bank is a label that includes the FCC Registration Number and Ringer Equivalence Number (REN) for this T1 Modem Bank. If requested, this information must be provided to the telephone company.

The REN is used to determine the number of devices you may connect to your telephone line and still have all of those devices ring when your number is called. In most, but not all, areas, the sum of the RENs of all devices connected to one line should not exceed five (5.0). To be certain of the number of devices you may connect to your line, as determined by the REN, you should contact your local telephone company to determine the maximum REN for your calling area.

If your T1 Modem Bank interferes with the network, the Telephone Company may discontinue your service temporarily. If possible, they will notify you in advance. If advance notice isn't practical, you will be notified as soon as possible. You will be informed of your right to file a complaint with the FCC.

Your telephone company may make changes in its facilities, equipment, operations or procedures that could affect the proper function of your T1 Modem Bank. If it does, you will be notified in advance to give you an opportunity to maintain uninterrupted telephone service.

## **Problems with your T1 Modem Bank**

If you experience trouble with your T1 Modem Bank, please contact Digi Technical Support for information on obtaining service or repairs. The telephone company may ask you to disconnect the T1 Modem Bank from the network until the problem has been corrected or you are sure that the equipment is not malfunctioning.

This equipment may not be used with coin-operated telephones. Connection to Party Line Service is subject to state tariffs.

# Industry Canada Compliance Statement

This Class A digital apparatus meets the requirements of the Canadian Interference-Causing Equipment Regulations. It complies with CSA 22.2 No. 950 for safety, ICES 003 for EMC, and ICCS 003 for Telecom.

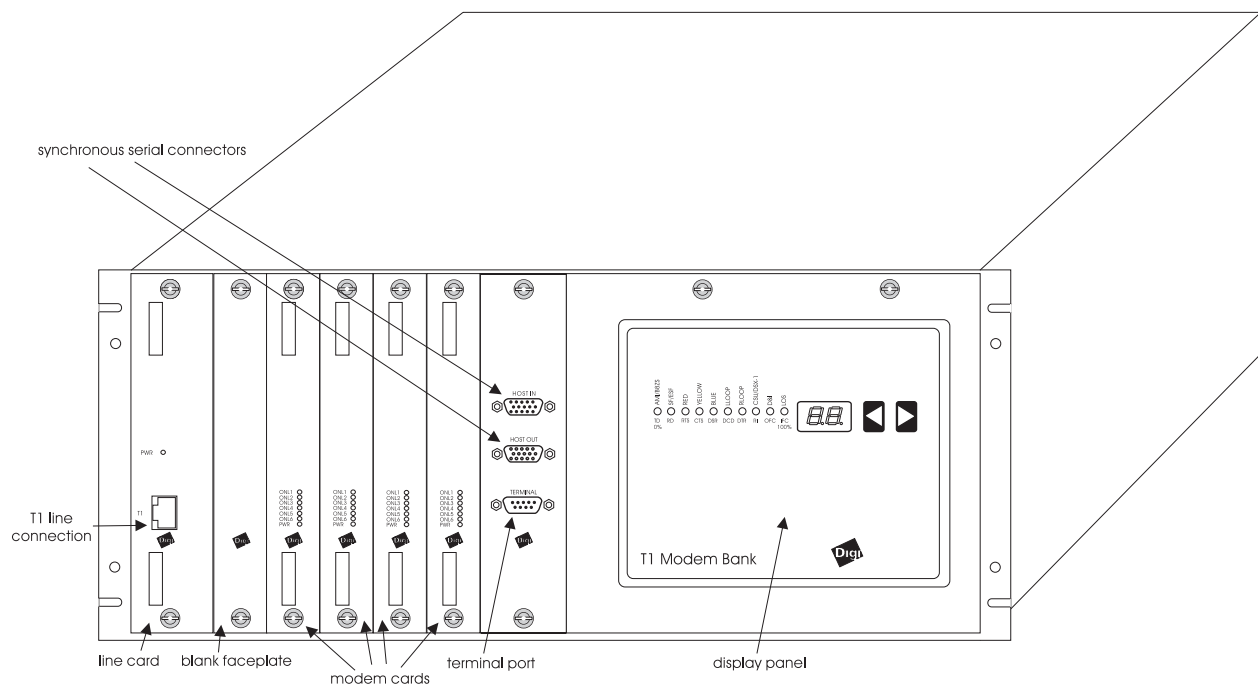
Cet appareil numérique de la classe A respecte toutes les exigences du Règlement sur le matériel brouilleur du Canada. Cet appareil est conformément aux exigences de CSA 22.2 No. 950 pour la sécurité, ICES 003 pour EMC et ICCS pour les télécommunications.

# AccelePort T1 Modem Bank Overview

The Digi AccelePort T1 Modem Bank is a high speed Wide Area Network (WAN) interface for Windows NT and Novell environments. The T1 Modem Bank system is composed of two major parts: a host-installed Enhanced Performance Concentrator (EPC/X) adapter and a rack mountable or table top system cabinet. Figure 1 shows a front view of the T1 Modem Bank system cabinet.

**Figure 1**

**T1 Modem Bank Chassis, Front View**



**Note:**

Some versions of the T1 Modem Bank have a second connector on the line card labeled "PBX." This connector is non-functional.

The T1 Modem Bank multiplexes up to 24 asynchronous V.34 modems onto one DS-1 (four-wire T1) WAN circuit. For a discussion of the terms and concepts related to T1 lines and the devices that connect to them, see "Connections to the Telephone Network" on page 77. The Glossary on page 83 defines the terms and acronyms used in this manual.

# Unpacking

Table 1 documents typical shipment packaging contents of the T1 Modem Bank. The components should be checked in upon arrival; notify your salesperson if the order is incomplete.

The T1 Modem Bank is shipped with proper shock insulation material. If the unit needs to be shipped, use the original shipping carton. If the original packaging is unavailable, contact Digi for replacement packaging.

**Table 1** **T1 Modem Bank Shipping Carton Contents**

Description	Part Number
The complete system includes:	
Carton 1	
System unit	50000471-xx
Accessory box	76000205
Power supply	50000468-01
Carton 2	
EPC/X Host Adapter	ISA            EISA            PCI 77000146      77000234      77000427
Available additional components:	
Power Supply card	76000206
T1 line card	76000207
Modem card	76000208
Fan card	76000209
T1 Modem Bank Installation Guide	90031300
Terminator plug	60000388

# Planning the T1 WAN Interface

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This section describes planning the T1 Modem Bank interface to the carrier facility. The configuration of the T1 Modem Bank must match the requirements of the T1 line specified by the carrier.

## Connections to the WAN

Connection to the telephone carrier facility is handled from the line card, via a T1 line.

### Carrier Approval

Contact your carrier for approval before beginning the actual installation. By doing this, you will help to ensure proper configuration of the line and the T1 Modem Bank. This protects the T1 Modem Bank and telephone network from damage due to an improper configuration.

After the T1 Modem Bank has been installed on the network, it is good practice to contact the carrier before removing or disconnecting the T1 Modem Bank. If you disconnect the T1 Modem Bank from the WAN, the carrier may suspend your T1 service. RJ-45 connectors are available which ensure loopback upon disconnection of user equipment to ensure that the line from the central office is properly terminated. Most T1 carriers provide a “smart jack” which will loop the T1 carrier when the T1 Modem Bank is disabled.

### CSU Mode

- When the line card is in the CSU mode of operation (also known as “Long Haul”), it supports 6,000 feet of 24 AWG twisted-pair cable.
- In the non-CSU mode of operation (also known as “Short Haul”), the DSX-1 function supports a maximum cable distance of 655 feet. This mode allows the T1 Line card to interface to PBX devices.

## Line Build Out

After the T1 Modem Bank is installed, the carrier will determine the correct setting for Line Build Out (LBO). However, certain determinations based on the following information will need to be entered into your computer.

- **CSU mode** Line compensation: Line attenuation can be set to one of the following: -0.0dB, -7.5dB, -15.0dB, and -22.5dB. Your T1 installer will inform you of the correct setting.
- **DSX-1 Mode** Transmit line buildout: For line compensation, your T1 installer will select a cable length between 0 and 655 feet based upon line length.

## CSU Specification

**Table 2**

**CSU Technical Description**

Line Frequency	1.544 Mb/s +/- 200 b/s
Line Code	AMI or B8ZS
Critical Circuitry Power Source	Dry Span, CSU powered form local AC power source
Line Framing	D4 or ESF
Line Loopback (LLB) Set Inband Code	(00001) repeating binary pattern (per AT&T Pub 54016 and ANSI T1.403)
Line Loopback (LLB) Reset Inband Code	(001) repeating binary pattern (per AT&T Pub 54016 and ANSI T1.403)
Line Build Out	0.0, -7.5, -15.0, or -22.5 dB of attenuation
Pulse Density and Consecutive Zeros Enforcement	In accordance with requirements of AT&T Pub 62411

## T1 Cable Specification

Transmitting T1 signals requires two 24 AWG stranded unshielded twisted pair Category 5 cables. A 15' cable meeting these specifications is shipped with the T1 Modem Bank.

## Parameters Specified to the Carrier

Certain parameters are specified to the carrier when provisioning the T1 line.

You will need to provide the following information to a T1 facility provider.

- Individual Access Line — Select the Phone service or Line Pooling Arrangement, which is sometimes termed *Multi-Hunt Grouping*. With Line Pooling, one phone number is assigned to a group of end terminals, and the first available terminal will receive the call.
- B8ZS or AMI line code — B8ZS is preferred.
- ESF or D4 framing format — ESF is preferred because of its enhanced diagnostic and maintenance capabilities.
- Supervisory Signaling Method — Robbed bit signaling; ground start, loop start, immediate start, or wink start
- Dual-tone Multi Frequency (DTMF) or pulse-dial addressing — DTMF preferred
- Be sure you ask for a “trunk-side” T1. Most carriers will provision “line-side” T1s by default, which will cause lower speed modem connections.

# Planning Worksheets

The T1 Modem Bank must be configured to match the provisioning of the T1 line from the carrier.

## General Information

Required information includes the following:

- The identity of the WAN manager for your local and remote sites
- The identification of the TELCO providing the WAN

**Table 3** Requirements for T1 Modem Bank Setup

Requirements	Description
Location of the T1 Modem Bank	The T1 Modem Bank must be positioned where it can be connected to the WAN within the specified cable limits.
Active T1 line	One or more active and installed T1 lines from the WAN service with at least two channels assigned.
Ground Start or Loop Start	CSU supervision mode
Circuit ID	Identifier used by the T1 provider to refer to the line. It refers only to the T1 line and is not associated with individual phone numbers. You must keep track of the circuit ID number for each line, since if you experience trouble on the T1 line, the service provider will need to know this number.

You can make as many copies as you need of the worksheet on the following page. A copy of this worksheet should also be filled out for both the local and remote sites.



T1 Modem Bank Worksheet		
Type	Number or Checkmark (√)	Description
Circuit ID #	_____	This is a code assigned by your service provider, one per T1 line
Lead phone number	_____	Master phone number or first phone in the sequence to receive a call.
Span Type	_____ _____	Long Haul Short Haul
Frame Format	_____ _____	ESF D4
Line Encoding	_____ _____	B8ZS AMI
Signaling	_____ _____	Ground Start Loop Start Wink Start Immediate Start
Attenuation	_____ _____ _____ _____  _____	Line Build-out: 0.0 dB -7.5 dB -15.0 dB -22.5 dB  Short haul distance: 0 - 655 ft.
EQ Gain (applicable only for Long Haul)	_____ _____	Low High

# Hardware Installation

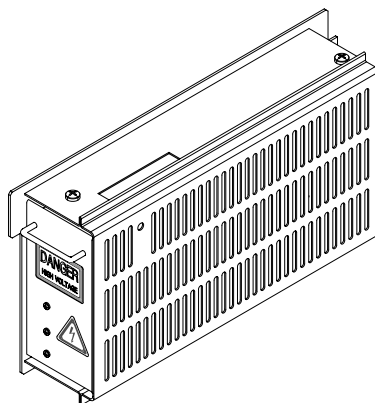
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This section describes the following procedures:

1. T1 Modem Bank power supply installation/replacement
2. T1 Modem Bank standalone or rack installation
3. T1 Modem Bank daisy chaining
4. EPC/X host adapter installation
5. EPC/X host adapter connection to the T1 Modem Bank units.

## T1 Modem Bank Power Supply Installation/Replacement

The T1 Modem Bank operates with either a single power supply installed or with two power supplies installed. Dual power supplies allow a T1 Modem Bank to share load balancing so that one power supply can take over if the other power supply becomes inoperable. To install a power supply (or supplies) into a new T1 Modem Bank unit, or to replace or add a power supply in an existing T1 Modem Bank unit, follow the directions in this section. See “Power Supply Removal” on page 73 if you need instructions for removing a power supply from a T1 Modem Bank.

**Important!**

- You can install a second power supply into a T1 Modem Bank that already has an existing power supply installed without having to power-down the T1 Modem Bank.
  - Wear a grounding strap while performing this procedure to prevent electrical discharge.
  - Avoid touching the fan during this procedure since the fan blade could cause harm.
  - When handling the power supply printed circuit board, do not touch the edge connector that connects to the distribution board because damage to the board may result.
1. If the display panel faceplate on the T1 Modem Bank is closed, loosen the two captive screws on the display panel faceplate; carefully pull down the hinged display panel faceplate.
  2. Slide the power supply into an available slot. It may be necessary to apply some force to properly seat the power supply.
  3. Use the ON/OFF switch at the back of the T1 Modem Bank to power it up if it is not already powered-up. If you installed a second power supply into a unit while the unit was powered-up, no reset is needed because hot swap capabilities are integrated on power supplies.
  4. It may take a few seconds for the LED on the power supply board to light to indicate that the power supply is operational.

# T1 Modem Bank Standalone or Rack Installation

You have the option of using the T1 Modem Bank in a standalone, table-top configuration or in a rack-mounted configuration. Directions for both configurations are provided in this section.

## **Important!**

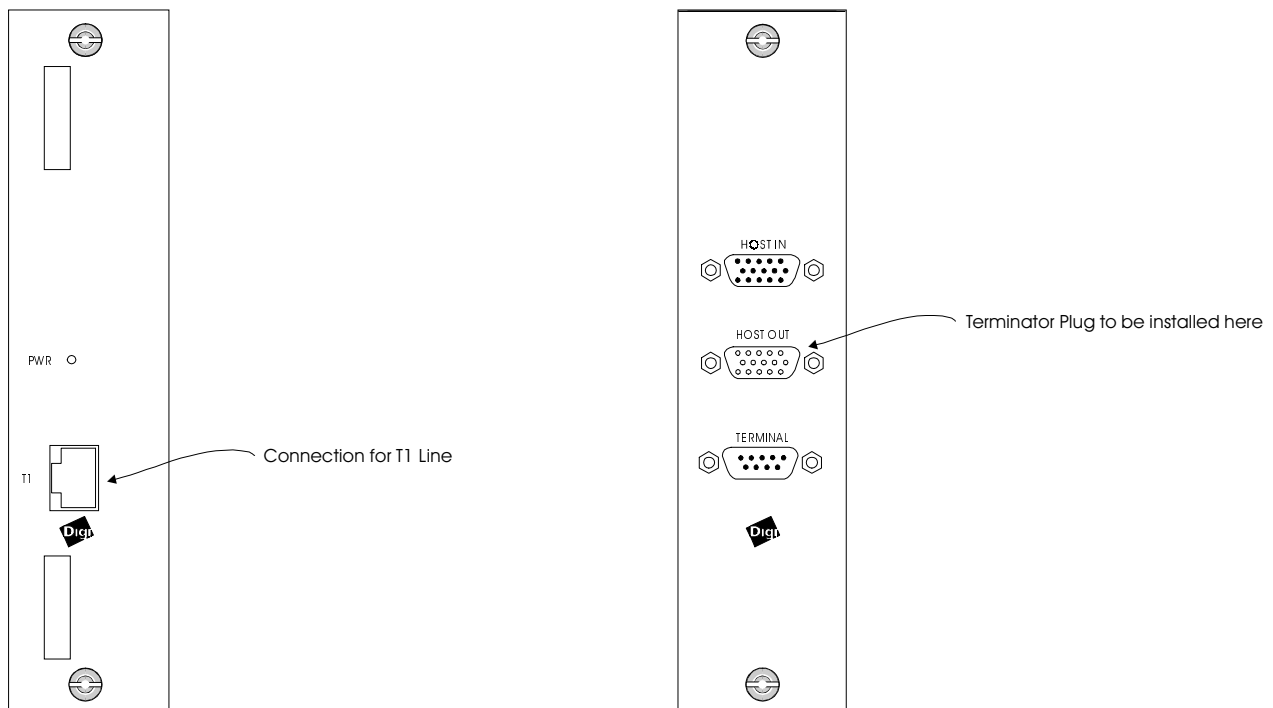
- Make sure the T1 Modem Bank is powered-down before you install it.
- Do not block the sides of the T1 Modem Bank since this will impede airflow.
- The T1 Modem Bank is shipped from the factory with four “feet” installed on the bottom of the unit. If you remove the feet, you must ensure that the T1 Modem Bank will have at least 1U (1.75 inches) of clearance beneath it in order to prevent airflow from being impeded.

## Standalone Installation Procedure

**Tools needed:** Phillips screwdriver; flat blade screwdriver

1. Place the T1 Modem Bank on a flat surface within 6' 7" (2m) of a power outlet.
2. Attach the terminator plug to the connector labeled HOST OUT on the HOST IN/OUT and Terminal faceplate. See Figure 3.
3. Plug the power cord into an outlet.
5. Insert the RJ-45 plug on the T1 line cable into the jack marked T1 on the Line card faceplate. See Figure 3.
6. Refer now to the instructions in "EPC/X Host Adapter Installation" on page 19.

**Figure 3** Line Card and Synchronous Cable Connections for Standalone T1 Modem Bank



## Requirements for Rack Installations

The T1 Modem Bank chassis is made to be inserted into a standard 19-inch or a 24-inch equipment rack. The T1 Modem Bank is shipped from the factory with two rack-mounting brackets (“ears”) installed for a 19-inch rack. If you wish to install a T1 Modem Bank into a 19-inch rack, go now to the instructions in “General Rack Installation Directions” on page 14. Before you can install a T1 Modem Bank into a 24-inch rack, you must first remove the rack-mounting brackets and then re-install them in the correct position for a 24-inch rack.

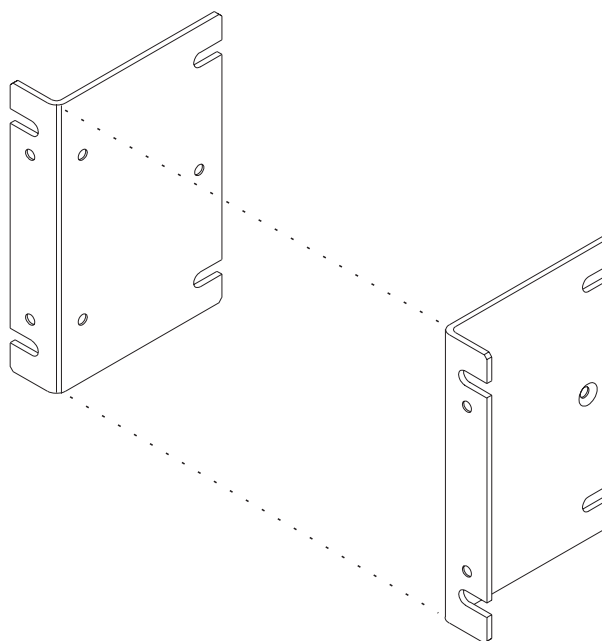
### *Mounting Bracket Installation for a 24-inch Rack*

**Tools needed:** Phillips screwdriver; flat blade screwdriver

1. The rack-mounting brackets must be removed from their 19-inch rack position. Remove the three screws that fasten each of the brackets to the chassis. (See Figure 4).

**Figure 4**

**Bracket Position For 19-inch Rack**



2. Re-install the brackets so that the long sides of the brackets extend outward from the chassis; the shorter sides of the brackets must be flat against the sides of the chassis as shown in Figure 5.

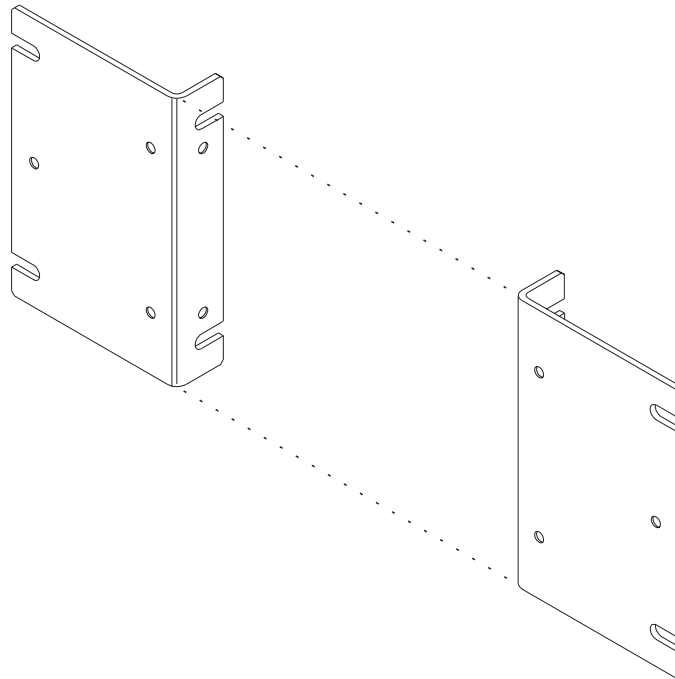
3. Line up the circular holes in a bracket with the circular holes on a side of the T1 Modem Bank, and use two of the screws to fasten the bracket to the chassis.



Do not use the oval slots on a bracket to connect the bracket to the T1 Modem Bank.

**Figure 5**

**Bracket Position For 24-inch Rack**



4. Follow “General Rack Installation Directions” on page 14 when you have installed two brackets to each T1 Modem Bank unit.

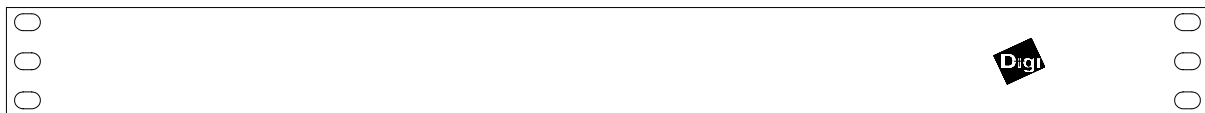
## General Rack Installation Directions

### **Important!**

- When multiple units will be mounted in the rack, install a T1 Modem Bank unit in the first chassis slot at the bottom of the rack, then work upward. This prevents cables from becoming tangled, and it maintains the lowest possible center of gravity to prevent the rack from falling over.
- Multiple T1 Modem Bank units within the confined space of a rack may cause higher operating temperatures. The recommended maximum external ambient operating temperature of a T1 Modem Bank unit is 40° C. Since the T1 Modem Bank takes in air from the vent on the bottom of the unit and exhausts the air out the vent on the side, make sure that neither vent is blocked. The T1 Modem Bank is shipped from the factory with four “feet” installed on the bottom of the unit. If you remove the feet, you must ensure that each T1 Modem Bank will have at least 1U (1.75 inches) of clearance beneath it in order to prevent airflow from being impeded. You may connect a Digi-supplied spacer (See Figure 6) to the rack between each T1 Modem Bank unit in order to ensure the required clearance. In general, eight T1 Modem Bank units can be stacked in a six-foot rack; five units can be stacked in a 4-foot rack.
- The power cord is limited to 6’ 7” (or 2 m) in length. This is sufficient since most racks provide internal power outlets.
- The T1 Modem Bank is rated at 1.2 Amps when the current is drawn from a 125 V AC supply. Due to the nature of the internal switching power supply, the power rating of the AC supply circuit should be derated to 75% of its rated capacity when calculating how many units can be connected to the AC supply. For example, a 15 Amp circuit should be derated to 11.25 Amps.
- The T1 Modem Bank should be used only with earth grounded outlets. The earth ground connection of the three prong cord should be maintained even when the unit is not connected directly to the AC supply line through a power strip.

**Figure 6**

**T1 Modem Bank Unit Spacer**

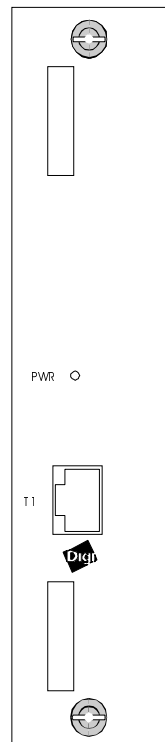




1. Installing the T1 Modem Bank into the rack requires two people since the T1 Modem Bank is heavy. Note that handles are provided on the T1 Modem Bank to aid in rack installation. They are part of the chassis and are located on the front of the T1 Modem Bank near the outer edges of the chassis. As one person holds the chassis in the appropriate location in the rack, the other person must ensure that **all** the oval slots on the rack-mounting brackets line up with the correct holes in the rack before fastening the chassis to the rack with the screws provided. Tighten all the screws with a screwdriver.
2. Repeat step 1 to install other T1 Modem Bank units in the rack.
3. Plug the power cord of each T1 Modem Bank into an outlet.
4. Insert the RJ-45 plug from the T1 line cable into the T1 jack on the Line card faceplate for each T1 Modem Bank and label the cable. (See Figure 7). A suggested method of labeling is to label each T1 line alphabetically, starting from the top.
5. Refer to the next section, “Daisy Chaining T1 Modem Bank Units.”

**Figure 7**

**Line Card**

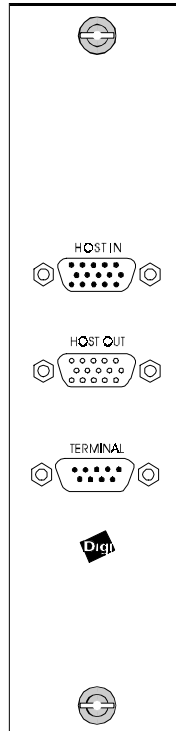


## Daisy Chaining T1 Modem Bank Units

The HOST OUT connector of each unit must be connected to the HOST IN connector of the next unit in the daisy chain. A terminator plug is then installed on the HOST OUT connector of the last unit in the daisy chain. See Figure 8.

**Figure 8**

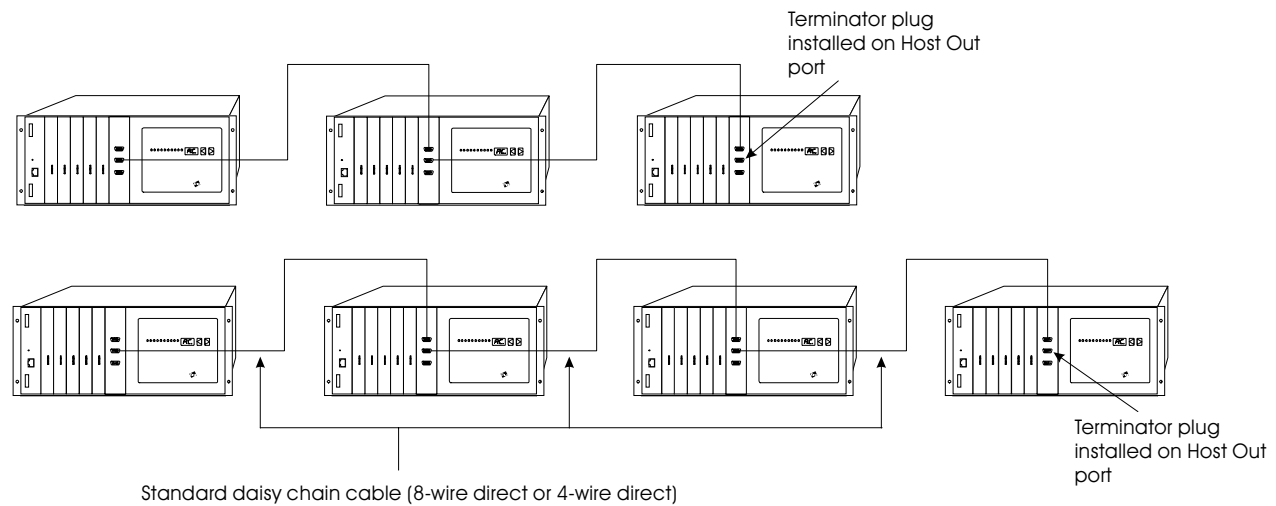
**Synchronous Ports and Terminal Port**



## Daisy Chain Example

While setting up daisy chains, refer to the example shown in Figure 9 and the directions that follow.

**Figure 9** Two Daisy Chains of T1 Modem Banks to be Connected Locally



### Note:

You can connect whatever number of T1 Modem Bank units you want in each of 2 daisy chains, as long as the total number of units in both daisy chains does not exceed 7 for each EPC/X host adapter that will be installed in your computer. For example, all 7 of the units in Figure 9 could be connected in one daisy chain, and there would be no units in the second daisy chain.

1. Use daisy chain cables to connect the HOST OUT port of each T1 Modem Bank to the HOST IN port of the T1 Modem Bank which is next in the chain.
2. Connect the terminator plug to HOST OUT on the last T1 Modem Bank in the rack to allow loopback to the motherboard.
3. Label and secure all cables.

**Important!**

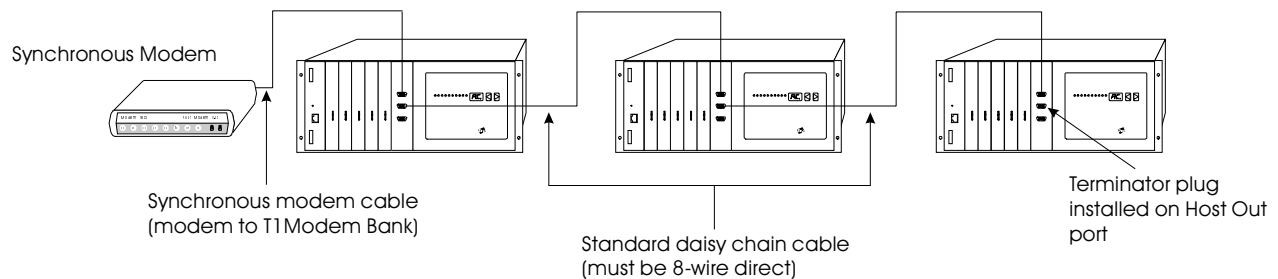
- Do not connect wires to pins 12 or 13 in a standard daisy chain cable—serious damage could result.
- Never use VGA extension cable or any other cable that has all 15 pins wired.
- Do not use a standard DB15 video cable
- To build a custom daisy chain cable, follow the wiring mode shown in Figure 33 on page 94 or Figure 34 on page 95. Alternatively, contact your Digi sales representative.

## Connecting a Modem

To connect a modem to T1 Modem Banks, use the cabling shown in Figure 35 (page 97) or Figure 36 (page 98), depending upon your modem type (RS-232 or RS-422). Connect additional T1 Modem Bank units with Eight-Wire Direct cables (or the standard daisy chain cables shipped with the unit) as shown in Figure 10. Be sure to install the terminator plug on the HOST OUT port of the last T1 Modem Bank.

**Figure 10**

**Remote T1 Modem Bank Units**



## Daisy Chaining T1 Modem Bank Units and EPC/CON-16 Concentrators

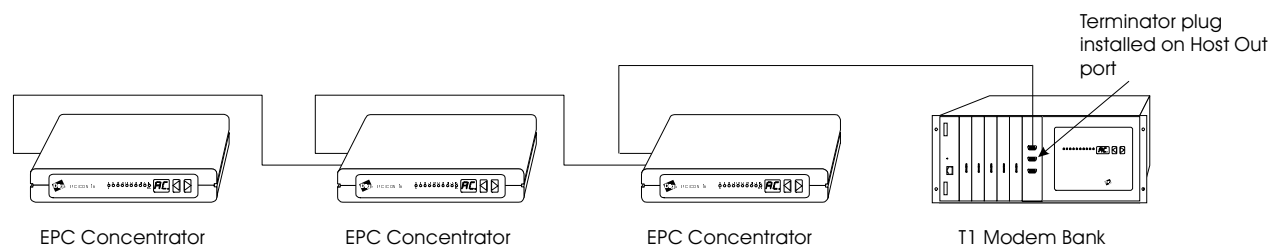
A T1 Modem Bank can be installed in an existing system comprised of EPC/CON-16 concentrators. See Figure 11.

### Note:

- Because existing EPC concentrators are assigned node numbers by the host each time the software is booted, any added T1 Modem Bank units must follow the EPC concentrators in the daisy chain.
- The last T1 Modem Bank in a daisy chain must have a terminator plug installed on its HOST OUT port. Individual T1 Modem Bank units are not shipped with terminator plugs. Terminator plugs are shipped with EPC/X host adapters only.
- All EPC concentrators which will be connected to the EPC/X host adapter via synchronous modems must be of the newer type (plastic) if a T1 Modem Bank is to be added to the system.

Figure 11

Mixing EPC Concentrators with T1 Modem Bank Units



## Fault Tolerance

T1 Modem Bank units are assigned physical node numbers (set by the operator during installation—see page 27). The node number is used to route data to and from a specific T1 Modem Bank unit. If a particular T1 Modem Bank is turned off or removed from the daisy chain, the 24 channels on that T1 Modem Bank become unavailable to the system, but the rest of the system remains unaffected. Since the T1 Modem Bank unit's HOST IN and HOST OUT ports are of the opposite gender, a T1 Modem Bank can be removed from the middle of a daisy chain, and the cables can be connected so that the chain remains unbroken. To remove the last T1 Modem Bank unit, simply plug a terminator plug into the end of the daisy chain cable.

When the hook-up is complete, go to "EPC/X Host Adapter Installation" on page 19 for further instructions.

# EPC/X Host Adapter Installation

The Digi EPC/X host adapter is an intelligent dual-channel synchronous communication board which plugs into a slot in your computer's bus. The adapter provides an interface between the computer and a single T1 Modem Bank or a series of daisy-chained T1 Modem Banks and/or EPC concentrators.

## **Important!**

Before installing your Digi EPC/X host adapter, be sure to write down its serial number.

## PCI Host Adapters

### *Configuring the Host Adapter*

No hardware configuration is required for PCI host adapters.

### *Installing the PCI Host Adapter in your Computer*

1. Turn off your computer's power and remove the cover. Refer to your computer's manual for instructions on cover removal and option board installation and cautions.
2. Locate an available PCI slot in your computer and remove the slot plate.
3. Plug the host adapter into the PCI slot and screw the endplate to the computer chassis.
4. Replace your computer's cover.

## **Note!**

PCI EPC/X host adapters are shipped with a diagnostic diskette. The MS-DOS based diagnostic program, **UD-PCI.EXE**, will help verify correct installation of the host adapter, and help identify possible hardware problems. See the text file, **USERPCI.TXT**, for complete instructions, and **RELNOT-P.TXT** for release information.

5. When you have verified that the host adapter has been correctly installed, follow the instructions in "Connecting the EPC/X Host Adapter to the T1 Modem Banks" on page 25.

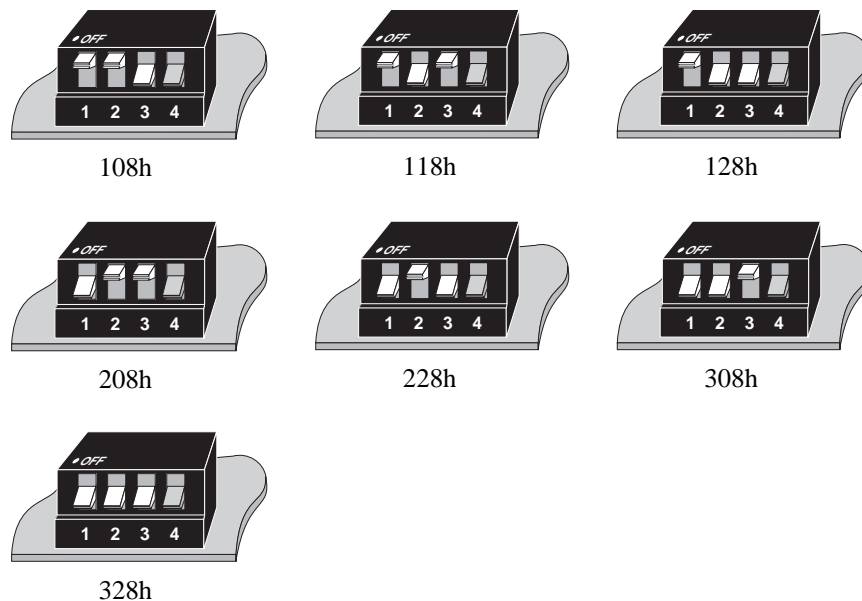
## ISA Host Adapters

### *Setting the I/O Port Address*

The ISA EPC/X host adapter uses four bytes of address space on the host computer's I/O bus. Before installing the host adapter, the board's I/O port starting address must be set on DIP switch SW1 (located on the top of the board). To insure flexibility, seven I/O port address ranges are available: 108h-10Bh, 118h-11Bh, 128h-12Bh, 208h-20Bh, 228h-22Bh, 308h-30Bh and 328h-32Bh. Choose one of the starting addresses and set SW1-1, 2 and 3 as shown in Figure 12 below.

**Figure 12**

**DIP Switch Settings for I/O Port Address**



### **Note:**

Record the I/O port address that you set. You will need to know the address when you install the device driver.

***Factory-Set Jumper J1***

There is one jumper, J1, on the host adapter. This jumper is set in the factory and must not be changed.

***Installing the ISA Host Adapter in your Computer***

1. Turn off your computer's power and remove the cover. Refer to your computer's manual for instructions on cover removal and option board installation and cautions.
2. Locate an available 16-bit AT slot in your computer and remove the slot plate.
3. Plug the host adapter into the ISA slot and screw the endplate to the computer chassis.
4. Replace your computer's cover.
5. Go to "Connecting the EPC/X Host Adapter to the T1 Modem Banks" on page 25.



# EISA Host Adapters

## *Factory-Set Jumpers*

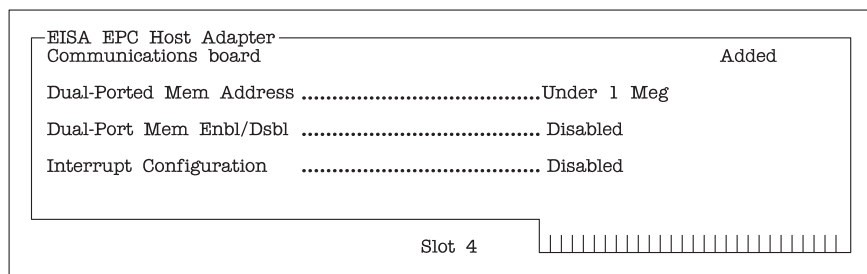
There are three jumpers, J1-J3 on the EISA EPC/X host adapter. These are set in the factory, and must not be changed.

## *Installing the EISA Host Adapter in your Computer*

1. Turn off your computer and disconnect any attached peripheral devices.
2. Remove the cover from the computer. Refer to your system's documentation for cover removal instructions and for other add-in board installation instructions and precautions.
3. Unscrew and remove the external slot cover plate from the slot into which you wish to install the EPC/X host adapter.
4. Carefully insert the EPC/X host adapter into the slot in the computer. Press the board firmly into the EISA bus connector, and replace the screw in the host adapter's endplate.
5. Replace the computer's cover.

## *System Configuration*

1. Boot up your EISA system with the EISA Configuration Diskette. During the boot-up process, the system should display a message to the effect that an unknown board has been found. This is the EPC/X host adapter installed in the previous procedure.
2. When the boot-up has been completed, copy the file **!DBI0301.CFG** from the Digi distribution diskette to your EISA system's Configuration Diskette.
3. Run the configuration program to add the EISA host adapter.
4. From the **Edit** pull-down menu, select **Add**. The program will display a list of the **.CFG** configuration files for boards; select **EPC/X Host Adapter**. (If this is not displayed as an option, you may not have copied the **.CFG** file to the correct directory in Step 2.)
5. Use a mouse, or the arrow keys and Tab key to pull down the **View** menu, and choose **Detailed by Slot**. Next, use the up and down arrow keys to move to **"EPC/X Host Adapter"** and press <Enter>. You should see a screen similar to the following:



- Place the cursor on “**Dual-Ported Mem Address**” and press <Enter>. A screen similar to the following will appear:

Memory Address      Type: OTHER

- ( ) 80000h
- ( ) 88000h
- ( ) 90000h
- ( ) 98000h
- ( ) A0000h
- ( ) A8000h
- ( ) B0000h
- ( ) B8000h
- (\*) C0000h
- ( ) C8000h

Size      (\*) 8000h

The following address choices are available:

***Below 1 Megabyte:\****

80000h	88000h	90000h	98000h
A0000h	A8000h	B0000h	B8000h
C0000h	C8000h	D0000h	D8000h
E0000h	E8000h	F0000h	F8000h

***Above 1 Megabyte:***

F0000000h F1000000h F2000000h F3000000h  
 F4000000h F5000000h F6000000h F7000000h  
 F8000000h F9000000h FA000000h FB000000h  
 FC000000h FD000000h FE000000h FF000000h

- \* Although there are 16 choices offered for memory start addresses below 1 megabyte, a limited number of these choices is likely to be available. Of the 16, the best choices are probably **D0000** and **D8000**. See Appendix A on page 85 for more information.

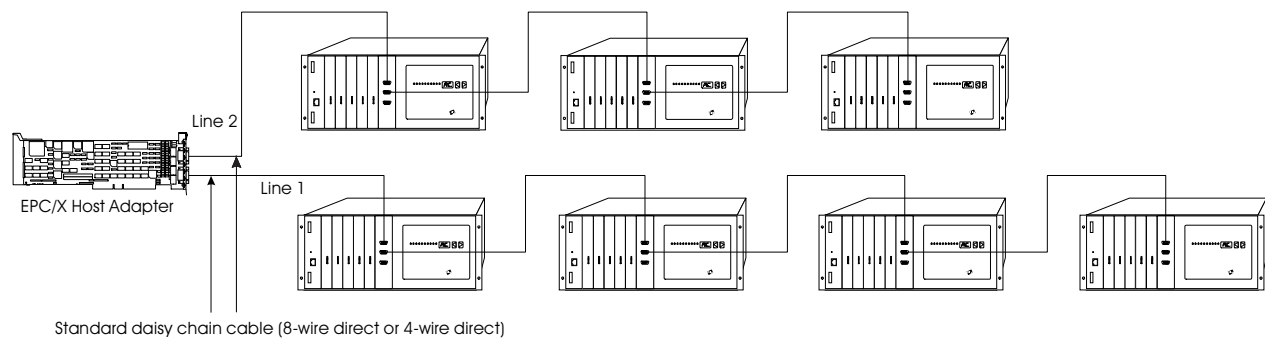
*Multiple EISA EPC/X host adapters may share the same addresses.*

- Use the cursor keys to select one of the listed addresses, or press <Enter> to accept what the configuration program has chosen. Write this address down—you will need to know it when installing the device driver software.
- Leave the **Dual-Port Mem Enbl/Dsbl** at “**Disabled**”.
- Leave the **Interrupt Configuration** at “**Disabled**”.
- Pull down the **SYSTEM** menu, and choose “**Exit**”. Make sure that you **SAVE** the new configuration as the program suggests.
- Go to “Connecting the EPC/X Host Adapter to the T1 Modem Banks” on page 25.

## Connecting the EPC/X Host Adapter to the T1 Modem Banks

To locally connect the EPC/X Host Adapter to the T1 Modem Bank(s), connect the daisy chain cable from the EPC/X host adapter line connector to the HOST IN connector on the first T1 Modem Bank in the daisy chain. (See Figure 13.) At the T1 Modem Bank end, label the cable “to Host EPC.”

**Figure 13** EPC/X Host Adapter Connected Locally to T1 Modem Banks



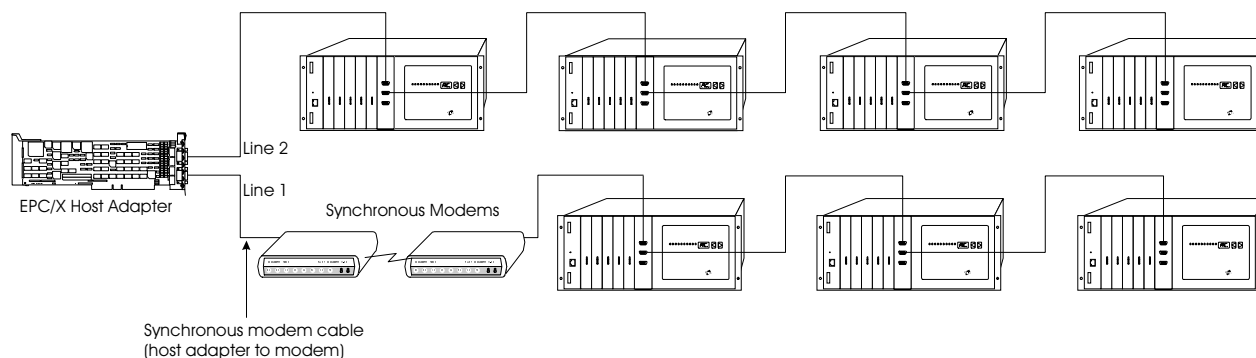
**Note:**

If only one EPC/X host adapter synchronous line is to be used, it must be line 1—the bottom connector.

To connect the EPC/X host adapter to the T1 Modem Bank(s) via modems, follow the example in Figure 14.

**Figure 14**

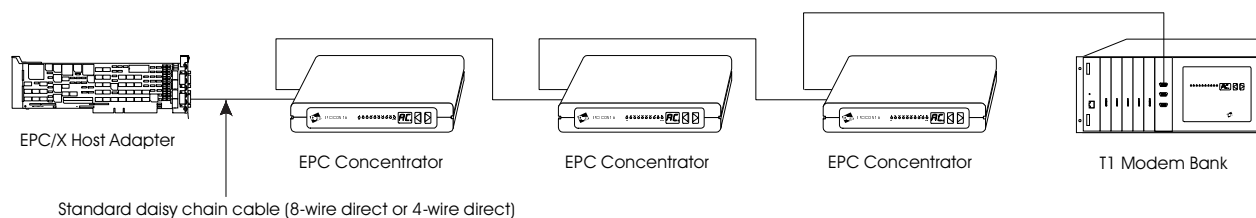
**Local and Remote T1 Modem Bank Units**



To connect the EPC/X host adapter to a system comprised of EPC/CON-16 Concentrators and T1 Modem Banks, follow the example in Figure 15.

**Figure 15**

**EPC/X Host Adapter Connected to Concentrators and T1 Modem Bank Units**



**Note:**

Because existing EPC concentrators are assigned node numbers by the host each time the software is booted, the EPC concentrators must be electrically closest to the EPC/X host adapter, and any added T1 Modem Bank units must follow the EPC concentrators in the daisy chain.

When you complete connecting the EPC/X host adapter to the T1 Modem Banks, follow the instructions in “Software Installation and Configuration” on page 27.

# Software Installation and Configuration

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## Setting the Node Number

The EPC/X host adapter identifies T1 Modem Bank units and/or EPC concentrators by their node numbers, which are stored in non-volatile RAM (NVRAM). Each T1 Modem Bank and concentrator in a daisy chain must have a unique node number which must be set during installation. The node numbers must be assigned in ascending order with the lowest number assigned to the T1 Modem Bank or concentrator closest to the EPC/X host adapter. It is permissible to skip node numbers to facilitate insertion of additional T1 Modem Bank units at a later date as long as the ascending sequence is maintained. If node numbers are not skipped, the node numbers of added T1 Modem Bank units must begin with a number that is greater than the total number of existing T1 Modem Bank units and/or EPC concentrators in a daisy chain.

### Note:

When setting up remote T1 Modem Bank units, the node number of the *last* T1 Modem Bank on a sync line must be the same as the total number of T1 Modem Bank units that will be configured in the device driver software for that line. This is because the clocking mode for the last T1 Modem Bank is set by the device driver software for synchronous modem clocking. If the device driver has been configured for six T1 Modem Bank units on a sync line, the node number of the last T1 Modem Bank must be set to 6, regardless of the actual number of T1 Modem Bank units that are physically present on that line.

Similarly, fault tolerance is not effective if the last T1 Modem Bank of a remote string fails, because the software only programs that T1 Modem Bank, by its node number, for synchronous modem clocking. The other T1 Modem Banks are all set for regular (8-wire direct) clocking. If the last T1 Modem Bank in a remote string fails or is removed for any reason, you must either reconfigure the device driver software for one less T1 Modem Bank, or change the node number of the next-to-last T1 Modem Bank to the number of the T1 Modem Bank that was removed. If you change a T1 Modem Bank's node number, be sure to reboot the T1 Modem Bank (power off and then on) so that the host system can reinitialize it properly.

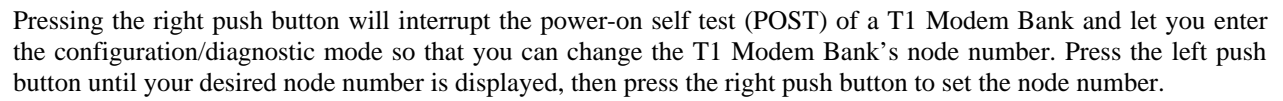
Node numbers must be correctly assigned in order for the T1 Modem Bank to properly function. If there is a problem, the COM port assignment may be incorrect, or two nodes may have been assigned the same number. This situation may arise if T1 Modem Bank units are swapped or moved, but the node numbers are not changed.

To set the node number on a T1 Modem Bank, activate the T1 Modem Bank by setting the power switch on the rear of the chassis to the ON (I) position. Soon after the lights on the display panel flash, press the right push button on the display panel (see Figure 16 on page 28) until the current setting is displayed (1n if directly from the factory).

### Note:

To avoid an error condition during the power-on self test (POST) of a T1 Modem Bank that you've added to existing T1 Modem Bank units and/or EPC Concentrators in a daisy chain, you must change the T1 Modem Bank's 1n (Node 1) factory configuration. Make sure you press the right push button on the display panel before POST is completed.

## T1 Modem Bank Display Panel



# Installing Download

Cycle the T1 Modem Bank's power off, then on again to restart POST. After a brief pause, the lights on the display panel will flash, and the T1 Modem Bank will begin the POST sequence, which takes about 2 minutes to complete. Once the POST is completed, P1 will be shown on the display panel to indicate that the T1 Modem Bank is ready for download. (If P1 is not shown, go to the section "POST Failure" on page 30 for instructions.)

P2 indicates that the PING signal has been received; P3 will flash briefly on the screen, indicating that the download has started. P4 indicates that a download is underway. At the same time, the LEDs will blink as packets are counted. The following sequence appears on the display panel: PE, D0, C1, C2, C3, C4. When the download is received and if the checksum has been validated, AC is then shown in the display, indicating that the T1 Modem Bank has been programmed, FEP is running, and the T1 Modem Bank is on-line. At this point, go to either "Software Installation for Novell Systems" on page 34 or "Software Installation for Windows NT Systems" on page 38.

# POST Failure

If the T1 Modem Bank does not pass POST, it will display an error message code on the seven-segment LED display and enter an infinite loop, waiting for the device to be reset. (Table 4 shows a list of the possible error message codes).

**Table 4** **Error Message Codes**

Code	Problem	Description
E0	Bad CPU	Writing all 1s/all 0s test to all registers failed to read back OK.
E1	Bad Watchdog	The watchdog does not reset the board, even when it has not been hit for 1.2 seconds, or it resets it even if it has been hit. This error also shows up if you power-cycle during the tests, since it cannot tell the difference between you cycling power vs. the watchdog triggering it when it should not.
E2	Bad ROM	Defective ROM checksum, or defective EEPROM (bad checksum or bad data).
E3	Bad RAM	RAM test failed.
E4	Bad timer	Timer test failed; timer cannot count, or will not interrupt, or will not stop interrupting.
E5	Bad Sync	The SCA sync failed. The loopback test failed, or it will not interrupt, or it will not stop interrupting.
E6	Bad line card	The line card failed to initialize or respond.
E7	Bad modem	No modems cards were found.
E8	Bad Misc.	Miscellaneous error. Currently goes on only if nothing has been downloaded for 15 minutes and the board resets itself.
E9	Bad Download	Download error - out of error packets, or bad checksum of packet, or more T1 Modem Bank units were found than were configured.
EA	Bad NVRAM configuration	EA indicates that the default configuration will be used because it did not pass the checksum when reading the NVRAM.  Default configuration in E <sup>2</sup> memory T1 Modem Bank. No valid config E <sup>2</sup> , use a default configuration of the default configuration of ground start (central office type trunk), AMI, and D4 framing.
EN	Bad node number	Error found on the node number. If the node number is out of range, or if a ping string references a number that is out of range, an error will occur. For example, if a ping string is configured to four nodes, and node five is referenced, an error would occur. In the case of duplicate node numbers, the T1 Modem Bank farthest from the EPC/X host adapter will display En instead of AC when the system is booted up.

If any of these error message codes is displayed, run the diagnostics program by following the instructions in “T1 Modem Bank Diagnostics” on page 56.



## Possible Problem

If at least one modem card is not inserted in the T1 Modem Bank unit, the line card will busy out the lines associated with that line card.

## Restarting POST

Cycle the T1 Modem Bank's power off, then on again to restart POST.

## Display Panel Status Indicators

Once the POST is completed, P1 will be shown on the display panel to indicate that the T1 Modem Bank is ready for download. P2 indicates that the PING signal has been received; P3 will flash briefly on the screen, indicating that the download has started. P4 indicates that a download is underway. At the same time, the LEDs will blink as packets are counted.

The following sequence appears on the display panel: PE, D0, C1, C2, C3, C4. When the download is received and if the checksum has been validated, AC is then shown in the display, indicating that the T1 Modem Bank has been programmed, FEP is running, and the T1 Modem Bank is on-line. At the same time, the LEDs on the display panel will appear to march one by one through the display panel LEDs. This process takes about 30 seconds. The user can then push the right or left arrow push buttons to cycle sequentially through the displays which are described in Table 5. The left push-button is used to program the T1 Modem Bank; the right is used to scroll through and locate the desired mode.

There are several classes of LED displays that appear on the display panel. Each class has a different meaning, as described below:

- CSU (Channel Service Unit) display—the text for CSU display is vertically positioned and appears as follows: AMI/B8ZS SF/ESF RED YELLOW BLUE L LOOP R LOOP CSU/DSX-1 D&I LOS. See the L1 description in Table 5.
- Channel variable—the seven-segment channel number indicates the node number of each modem found, ranging from 1 - 24. The text for the data and handshake signals is marked as TD RD RTS CTS DSR DCD DTR RI OFC IFC just above the LEDs on the display panel faceplate. See the CHAN # description in Table 5.
- Counters—encompass all other displays shown (See Table 5.) These counters use a percentage ranging from 0 to 100%, (shown below the LEDs in Figure 16 on page 28) and indicate line utilization, packet count, errors per second, processor utilization, and so on. Counters may be reset to 0 by pressing both buttons simultaneously. Counters provide a rough magnitude number. If more information is needed, QuickManager must be used.

Table 5

Display Panel Status Codes

7 Segment Display	Meaning	Description
AC	Activity	AC appears on the 7-segment display. The ten activity LEDs turn on sequentially from left to right. The speed of this “chase light” display increases with the overall activity level of the T1 Modem Bank.
LU	Line Utilization	LU appears on the 7-segment display, and the ten LEDs become a bar graph indicating the percentage (0-100%) of the time the synchronous communications line is being used.
PU	Processor Utilization	PU appears on the 7-segment display, and the ten LEDs become a bar graph indicating the percentage (0-100%) of the time the T1 Modem Bank’s microprocessor is being used.
PC	Packet Count	PC appears on the 7-segment display, and the ten LEDs show a binary representation of the total number of packets transmitted or received on the sync line between the EPC/X host adapter and the T1 Modem Bank. Pressing both push-buttons simultaneously resets the count to 0.
EC	Error Count	EC appears on the 7-segment display, and the ten LEDs show a binary representation of the total number of errors counted on the sync line between the EPC/X host adapter and the T1 Modem Bank. This indicates the quality of the line. Pressing both push-buttons simultaneously resets the count to 0.
L1*	T1 Line Card Status	<p>L1 appears on the 7-segment display and corresponds to the vertically positioned text. LED functions are as follows:</p> <ul style="list-style-type: none"> <li>• for AMI/B8ZS, AMI is indicated when the LED is lit, B8ZS is indicated when the LED is unlit.</li> <li>• for SF/ESF, SF is indicated when the LED is lit, ESF is indicated when the LED is unlit.</li> <li>• for CSU/DSX-1, CSU is indicated when the LED is lit, DSX-1 is indicated when the LED is unlit.</li> <li>• The RED, BLUE and YELLOW LEDs will be lit if there is a red, blue, or yellow alarm currently active on the T1 line.</li> <li>• The LLOOP LED will be lit if the remote switch has placed the line card in local loopback mode.</li> <li>• The RLOOP LED will be lit if the remote switch has placed the line card in remote loopback mode.</li> <li>• D&amp;I represents drop and insert.</li> <li>• LOS indicates loss of signal from the T1 line.</li> </ul>
ES*	Errored Seconds	An Errored Second is a second with one or more Error Events
Cr*	CRC Errors	A CRC error occurs when the CRC calculated by the T1 Modem Bank does not agree with the CRC received from the network.
bS*	Bursty Errored Seconds	A Bursty Errored Second is a second with more than one, but less than 320 CRC errors.
EE*	Error Events	A CRC error or a Loss Of Frame event

**Table 5 (continued)**

<b>7 Segment Display</b>	<b>Meaning</b>	<b>Description</b>
<b>SE*</b>	<b>Severely Errored Seconds</b>	A Severely Errored Second is a second with 320 or more CRC errors
<b>FS*</b>	<b>Framing Bit Errors</b>	An error in the Framing Bits received from the network
<b>LF*</b>	<b>Line Format Violations</b>	In AMI mode, any bipolar violation; in B8ZS mode, any invalid bipolar violation. A bipolar violation is an error in the encoding of binary 1's and 0's received from the network.
<b>CHAN</b>	<b>Display channels</b>	This display designates channel variables. The channel number appears on the 7-segment display. The ten LEDs correspond to the first row of labels on the front panel (TD, RD, RTS, CTS, and so on). The user may scroll through the 24 channels using the right push-button. The 7-segment display indicates which channel has been accessed.
<b>1n, 2n, 3n ... 8n</b>	<b>Node Number</b>	The seven-segment display shows the node number of the T1 Modem Bank. Select the desired mode (1n through 8n) using the left push-button. Refer to "Setting the Node Number" on page 27. The ten LEDs behave as in the AC display mode.

\* These status codes are related to the T1 (CSU) interface.

Go to either "Software Installation for Novell Systems" on page 34 or "Software Installation for Windows NT Systems" on page 38.

# Software Installation for Novell Systems

## Introduction

### Note:

Before software installation can proceed:

- The EPC/X adapters must be installed in the computer.
- The T1 Modem Banks must be connected to the EPC/X host adapters.
- The T1 Modem Banks must be powered on.
- The T1 Modem Bank node numbers must be set.
- A T1 line must be connected to the T1 connector on the line card of each T1 Modem Bank.

The driver will support up to four Digi EPC/X host adapters on ISA, EISA and PCI bus servers.

T1 Modem Banks and concentrators may be connected locally (direct wiring), or remotely (via high-speed synchronous modems). This driver supports one modem pair per synchronous line, and the modems must be installed between the host adapter and the first device (concentrator or T1 Modem Bank) in the daisy chain. Local and remote concentrators/T1 Modem Banks may not be combined on a single synchronous line.

Software installation for a Novell system which is directly connected to the T1 Modem Banks involves the following steps:

1. The EPC/X Novell NetWare AIO (Asynchronous Input/Output) device driver must be installed and configured.
2. An AIO application like NetWare Connect, FaxServe, or Wanderlink should be installed on the system to which the T1 Modem Banks are directly connected.
3. SNMP (Simple Network Management Protocol) must be configured if you wish to manage the T1 Modem Banks remotely with the management software ("QuickManager").
4. If you wish to remotely manage the T1 Modem Banks, install QuickManager on an NT system on your network.

### Note:

QuickManager does not currently support SNMP under Windows 95. Therefore, you can not manage a Novell system from a Windows 95 system.

5. Each T1 Modem Bank must be configured using DGT1CFG.NLM, QuickManager or the serial port.

## Installing the EPC/X AIO Device Driver

See the AccelePort EPC/X device driver installation instructions in the *Digi AccelePort Intelligent Serial Communications Products Novell AIO Device Driver Package Software Manual* (manual part no. 92000243). This manual is included with the T1 Modem Bank package.

## Installing the AIO Application

Follow the instructions in the Novell manuals to install NetWare Connect on the system to which the T1 Modem Banks are directly connected. Alternatively, you can use another AIO application like Cheyenne FaxServe or Funk Software's Wanderlink.

## Installing SNMP

SNMP is pre-installed on NetWare.

If you wish to manage the T1 Modem Banks remotely with QuickManager, you must follow these additional steps:

1. Configure the SNMP on the Novell system. This is done via the SNMP.NLM load line parameters or within INETCFG.NLM. Please see the Novell documentation for instructions.
2. Install SNMP on a Windows NT system on the network. Use the following procedure to install SNMP on the NT system:
  - a) Double click Control Panel.
  - b) Double click the Network icon.
  - c) When the "Network" window appears, select "Services", then click the "Add" button.
  - d) Select "SNMP Service."

## Installing QuickManager

If you wish to manage the T1 Modem Banks remotely with QuickManager, you will need to install QuickManager on a Windows NT system on your network. Use the following procedure to install QuickManager:

1. Insert the T1 Modem Bank NT Setup Disk into drive A of the remote system operating under Windows NT.
2. Run A:\SETUP.EXE.

## Configuring the T1 Modem Banks

- The instructions for configuring and managing T1 Modem Banks with QuickManager are in “Configuring via QuickManager” on page 41.
- Configuring the T1 Modem Banks with the DGT1CFG.NLM utility is described in this section.

### Note:

Although the DGT1CFG.NLM utility will configure the T1 Modem Banks, it can not perform management functions like advanced configuration, monitoring, and testing. For complete management capability of your T1 Modem Banks, you must install and use QuickManager.

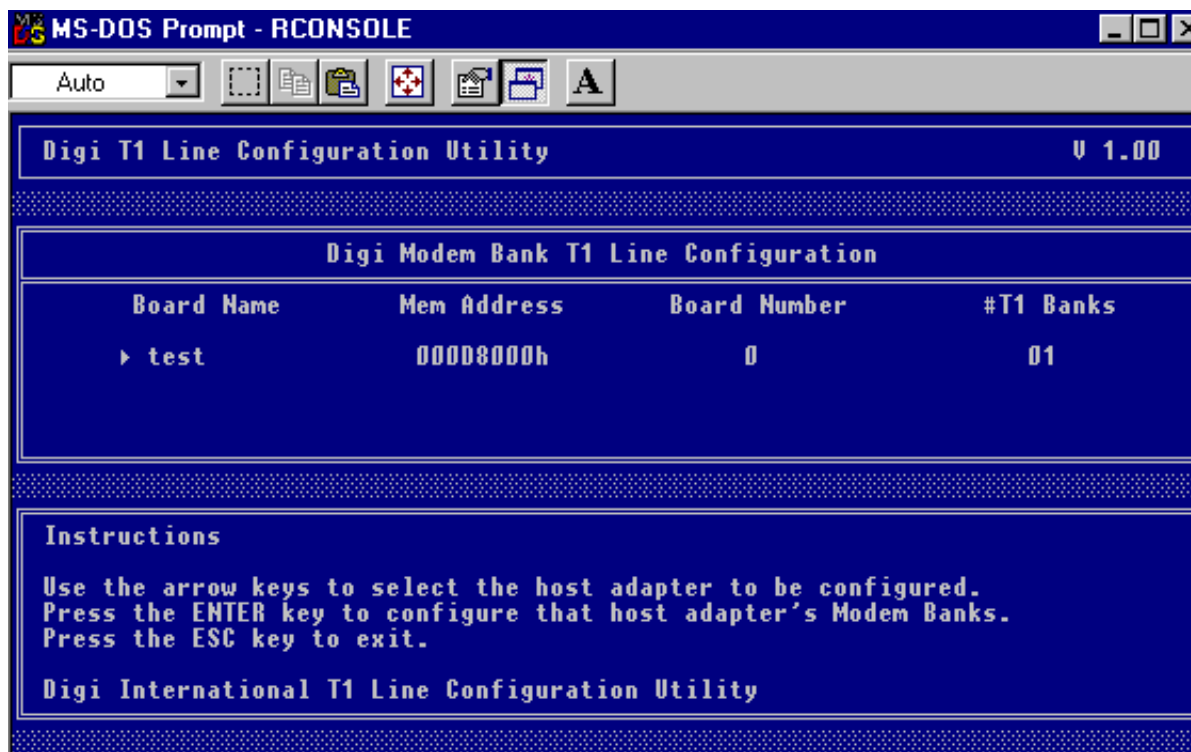
1. Make sure all T1 Modem Banks are powered on and display AC on their display panels.
2. Enter the following command:

**load dgt1cfg.nlm**

When the main menu appears, use the arrow keys to select the EPC/X host adapter that is connected to the T1 Modem Banks you wish to configure. (See Figure 17 for an example screen). Note that the field “#T1 Banks” indicates how many modem banks are connected to that EPC/X host adapter.

Figure 17

Main Screen



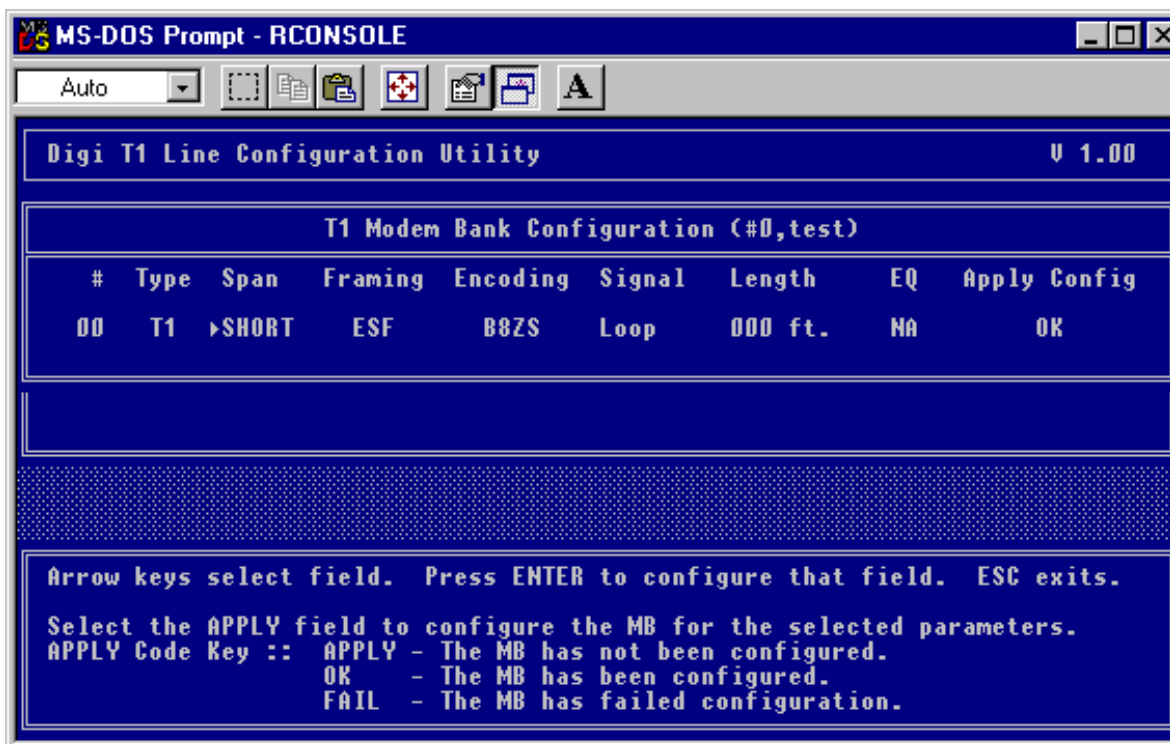
### Note:

All T1 Modem Banks should be ON and in the AC state before you select a board. If the T1 Modem Banks are not in the AC state, default parameters will initially be displayed, and any changes you make can not be saved. Instead, the default parameters will be saved. If the T1 Modem Banks are not in the AC state, see the section titled “POST Failure” on page 30 for instructions.

- Press the ENTER key to configure that host adapter's T1 Modem Banks. The “#” field in the example screen shown in Figure 18 indicates the number (beginning with 0) of the T1 Modem Bank you will be configuring.

**Figure 18**

**T1 Modem Bank Configuration Screen**



- Use the arrow keys to select the field you wish to change, and press the ENTER key to view a list of the options that are available for that field. Use the arrow keys to select the option you wish, and then press the ENTER key again to set the option for that field.

**Note:**

If you select SHORT for the “Span”, the “Length” field is in feet (0 to 655), and the “EQ” field is not applicable. If the span is LONG, then the “Length” field is in dB, and the “EQ” field is applicable.

- Once the desired settings have been selected, they must be applied to the T1 Modem Bank. Select the “Apply Config” field. A pop up box will indicate the success or the failure of implementing the setting assigned for each parameter.
- When you exit the program, you will be asked if you wish to save the current configuration. (If you applied all the settings, this question is unnecessary). Responding “Yes” will save all parameters to all T1 Modem Banks.

# Software Installation for Windows NT Systems

Software installation and configuration for a Windows NT system involves the following steps:

1. Install and configure the EPC/X Windows NT device driver on the host system (the system to which the T1 Modem Banks are directly connected).
2. Optionally install the Windows NT SNMP (Simple Network Management Protocol) service on the host system. If you plan to remotely manage the T1 Modem Bank via SNMP, install the SNMP service on the host prior to installing the management software.
3. Optionally install Windows NT RAS (Remote Access Service) on the host system. If you will be using RAS, it should be installed on the host system prior to installing the management software.
4. Install the management software on the host system.
5. Optionally install the management software (QuickManager portion) on remote systems located on your network. Remote systems must be running Windows NT or Windows 95. Windows 95 remote systems can manage only Windows NT Server based host systems.

## Installing the EPC/X Windows NT Device Driver

See the AccelePort EPC/X device driver installation instructions in the *Digi Intelligent Serial Communications Boards-Device Drivers for Microsoft Windows 95, Windows NT, Windows for Workgroups 3.11, Windows 3.1-Software Manual* (manual part no. 92000220).

## Installing the Windows NT SNMP Service

### *Windows NT 3.51*

The SNMP Service is part of the TCP/IP package for Windows NT 3.51.

1. Double click Control Panel.
2. Double click the Network icon.
3. When the “Network” window appears, click the button “Add Software.”
4. From the drop down list, select “TCP/IP Protocol and Related Components.”
5. Click the “Continue” button.
6. Click the check box for “SNMP Service.”
7. Click the “Continue” button to complete the installation.

If TCP/IP was not installed prior to this, you must complete the installation by answering the TCP/IP specific questions.



### **Windows NT 4.0**

1. Double click Control Panel.
2. Double click the Network icon.
3. When the “Network” window appears, select “Services”, then click the “Add” button.
4. Select “SNMP Service.”

## **Installing RAS**

Windows NT Remote Access Service (RAS) includes the following applications:

- Dial-Up Networking is the client version of RAS and is used to connect to dial-up servers. The Dial-Up Networking icon is located in the **My Computer** dialog box and in the **Accessories** folder on the **Start** menu.
- Dial-Up Networking Monitor, used to monitor connections and devices, is located in Control Panel.
- Remote Access Admin, used to monitor remote users connecting to a RAS server, is located in the **Administrative Tools** folder on the **Start** menu.

For more information about RAS, see the *Microsoft Windows NT Server Installation Guide* (Windows NT 3.5) or the *Microsoft Windows NT Server Networking Supplement* (Windows NT 4.0). More information is available in the file NETWORK.WRI located in the directory where NT is installed.

## **Installing the Management Software**

The management software setup program (software package part no. 75000219) installs support for local and remote management of the T1 Modem Banks connected to a host system. This software must be installed on the host system and can optionally be installed on remote systems. Setup requires Windows NT or Windows 95.

### **Host System Installation**

Host systems are Windows NT systems which have T1 Modem Banks and drivers installed. Remote management of the host system's T1 Modem Banks is available via SNMP. SNMP management applications (including QuickManager) may be used. For host systems running Windows NT Server, remote management from a Windows 95 system is also possible via QuickManager.

#### **Note:**

Before running the setup program on the host system, check the following:

- The EPC/X driver is installed and running (reboot after driver installation).
- Each T1 Modem Bank is connected and powered on.
- Each T1 Modem Bank has completed its download (AC is displayed on the front panel). If the T1 Modem Banks are not in the AC state, see the section titled “POST Failure” on page 30 for instructions.
- The T1 line is ready to be connected to the T1 Modem Bank.
- The list of operating parameters for the T1 line is available.
- If SNMP or RAS will be used, be sure to install and configure these first.

To run the setup program, insert the setup disk (part no. 40001468) into the drive and run SETUP.EXE.

Setup will perform the following steps:

1. Install local and remote management support files.
2. Install and run the ConfigWizard configuration utility.
3. Install and run the QuickManager management application.
4. Copy the SNMP MIBS (RFC1406, RFC1659 and DIGIT1E1.MIB).
5. Optionally install the Digi SNMP Proxy Agent.

When setup is complete, see the section “Configuring via QuickManager” on page 41.

### ***Remote System Installation***

Remote systems are systems running Windows NT or Windows 95 which will be used to remotely manage a host system's T1 Modem Banks. Using QuickManager, Windows 95 remote systems can manage only host systems that are running Windows NT Server.

To run the setup program, insert the setup disk (part no. 40001468) into the driver and run SETUP.EXE.

Setup will perform the following steps:

1. Install the QuickManager management application.
2. Copy the SNMP MIBS (RFC1406, RFC1659 and DIGIT1E1.MIB).

When setup is complete, see the section “Configuring via QuickManager” on page 41.

# T1 Modem Bank Configuration

The T1 Modem Bank can be configured in the field for specific network needs by one of four methods:

- **QuickManager mode**
- **DGT1CFG.NLM mode** (used on Novell systems only). See “Configuring the T1 Modem Banks” on page 36 for instructions on using the DGT1CFG.NLM utility.
- **terminal port mode**
- **display panel mode**

It is easier and less time-consuming to configure a T1 Modem Bank using QuickManager or DGT1CFG.NLM than to use the terminal port or the display panel. In addition, QuickManager can perform management functions like advanced configuration, monitoring, and testing.

## Configuring via QuickManager

QuickManager is started by clicking the “Digi” program group, and then clicking the QuickManager icon. (Clicking the ConfigWizard icon in the “Digi” program group allows you to initially configure the T1 Modem Banks, but ConfigWizard does not perform the management functions that QuickManager does). Clicking “Window” in the main menu will allow you to view the current configuration settings, change the configuration settings, or run a test on the selected component. (You can alternatively click the applicable button below the main menu). Figure 19 shows an example screen for the status of a line card.

Figure 19

Line Card Status Display

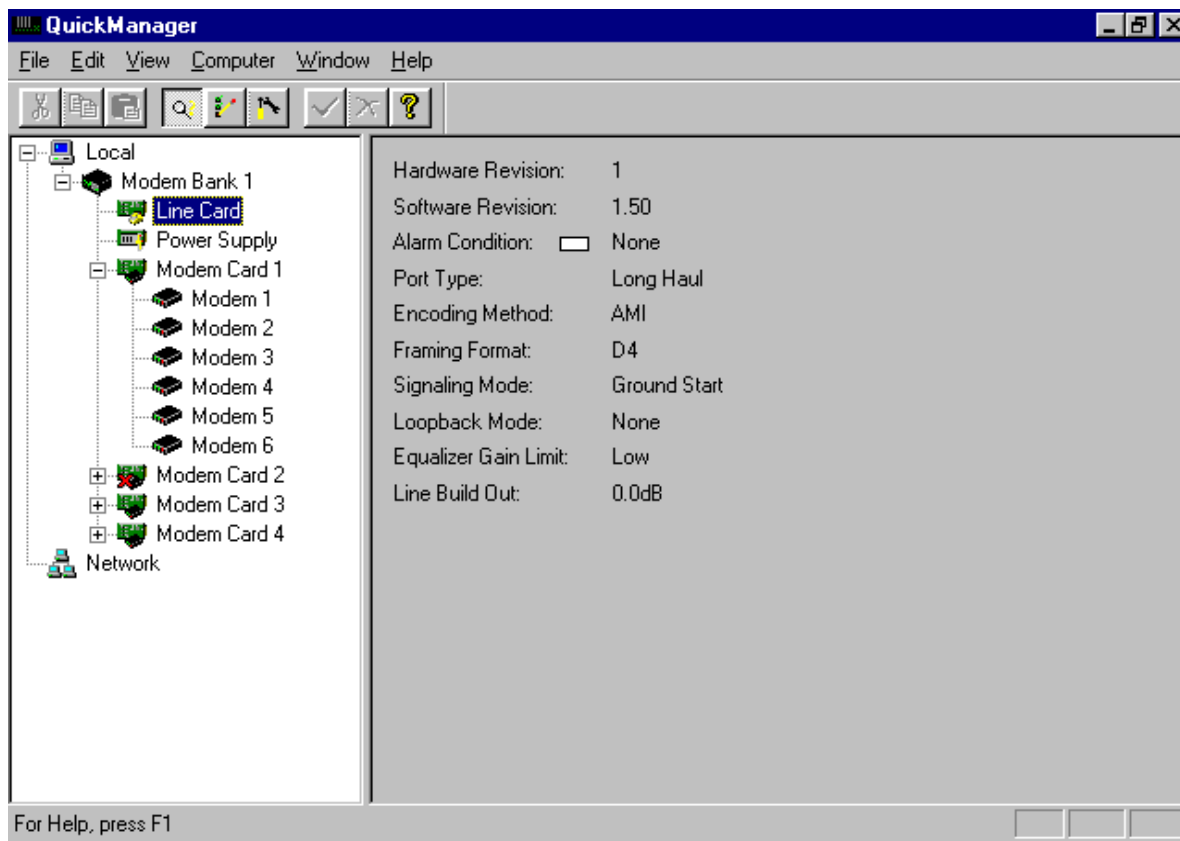
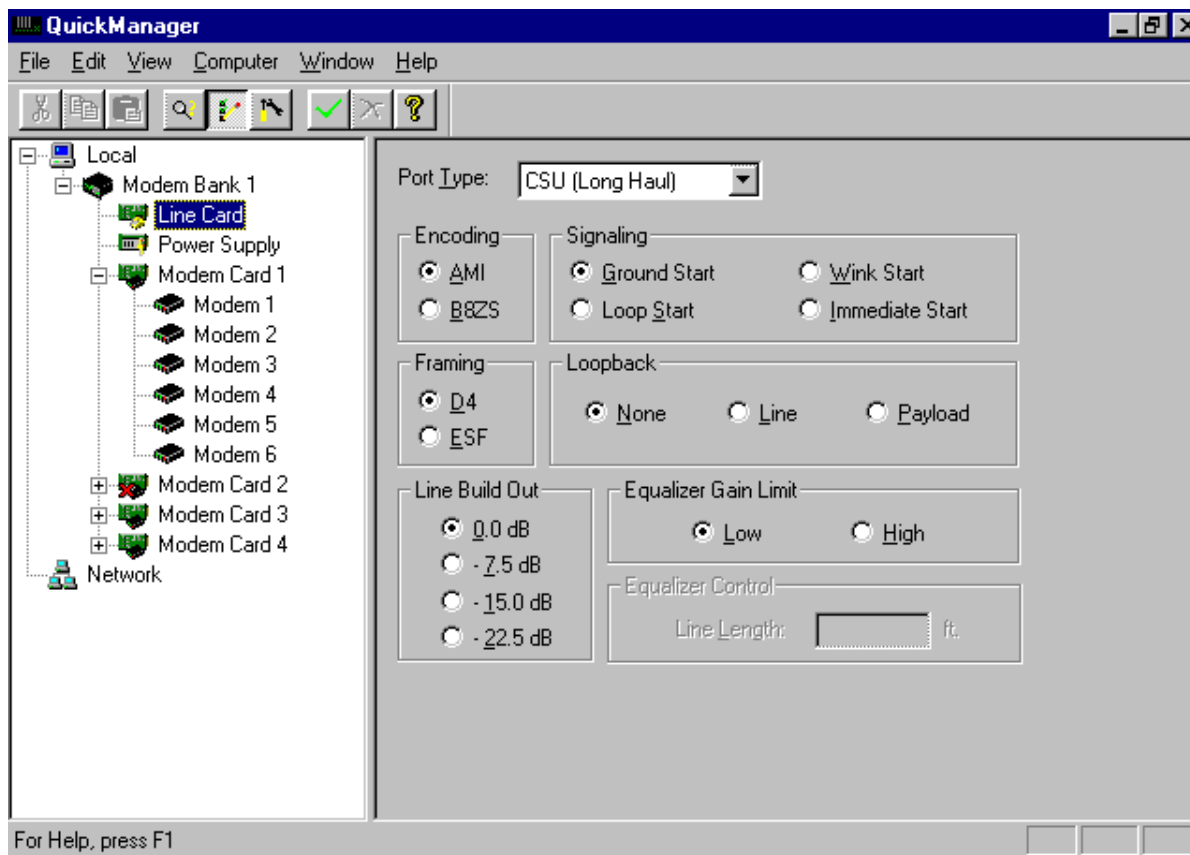


Figure 20 shows an example screen when “Line Card” and “Options” are selected.

**Figure 20**

**Line Card Options Display**



Once the desired settings have been selected for a component, they must be applied to the T1 Modem Bank. Select “Apply” from the “Window” menu or click the “Apply” button.

## Configuring via the Terminal Port

### Note:

To configure the T1 Modem Bank through the terminal port, follow these steps before starting up the T1 Modem Bank:

1. Make sure the T1 Modem Bank is shut off; then connect a terminal to the terminal port. Some terminals will not transmit data if their CTS (Clear To Send) line is LOW. These terminals must have their CTS line HIGH or floating to ensure that they will have no problems communicating with the T1 Modem Bank. Appendix C on page 91 shows a cable that can be used for these terminals.
2. Power up the terminal and set its communications parameters to 9600 baud, 8 data bits, no parity and 1 stop bit.
3. Power up the T1 Modem Bank and press ? on the terminal keyboard to bring up the configuration/diagnostic menu.

- Press N to set the node number
- Press L to set the line configuration

Press T for T1 line or D for Drop and Insert

If D, select a, b, c, d, or e (default a)      a) .6 dB      b) 1.2 dB      c) 1.8 dB      d) 2.4 dB      e) 3.0 dB

If T, select a or b (default a)      a) CSU Long Haul      b) DSX-1 Short Haul

If CSU, select a or b (default a)      a) AMI/D4      b) B8ZS/ESF

Select Jitter, EGL, or LBO

If Jitter, select a or b (default b)      a) Tx      b) Rx

If EGL, select a or b (default a)      a) 26 dB      b) 36 dB

If LBO, select a, b, c, or d (default d)      a) 0      b) -7.5      c) -15.5      d) -22

If DSX-1, select a, b, c, d, or e (default a)      a) .6 dB      b) 1.2 dB      c) 1.8 dB      d) 2.4 dB      e) 3.0 dB

By pressing <Enter> at any time, you may exit the configuration/diagnostic mode without saving any of your changes. The POST will then resume if it had not been completed at the time you entered configuration/diagnostic mode. If POST had been completed when you entered configuration/diagnostic mode, the download will begin when you exit configuration/diagnostic mode.

To exit the configuration/diagnostic mode and save your changes, cycle the T1 Modem Bank's power off, then on again to return to the initialized state.

## Configuring via the Display Panel

Power up the T1 Modem Bank and press the right push button on the display panel soon after the adjacent lights flash. Repeated pressing of the right push button will cycle through the following sequence:

- (1) Node number selection
- (2) T1 line configuration
- (3) Diagnostic tests

Pressing the left push button will allow you to change the parameter whose current value or setting is shown in the display panel.

The first thing shown on the display panel should be the T1 Modem Bank's node number. This will be displayed in the form  $xn$ , where  $x$  is the node number ( $1n$ ,  $2n$ , and so forth). (If the T1 Modem Bank has just been unpacked,  $1n$ , for Node 1, will be displayed). If you wish to change the node number, press the left push-button repeatedly until the desired node number appears on the display panel, then press the right pushdown to save it in EEPROM. If the new node number is successfully written to EEPROM,  $Pn$  will be displayed to indicate a pass condition. If the write operation failed,  $Fn$  will be displayed. See "Setting the Node Number" on page 27 for more information about node numbers. If you do not wish to change the node number at this time, press the right push-button again to proceed to the Line Card configuration test.

The following describes the display panel configuration/diagnostic process:

- |                 |                              |  |
|-----------------|------------------------------|--|
| 1. Press Right  | Displays current node number | Press Left changes node number                       |
| 2. Press Right  | Line Card T1 Line Select     | Press Left selects Line Interface or Drop & Insert   |
| 3. Press Right  | goes to Diagnostic Test 1    | (if no left press at Line Card T1 Line Select)       |
| 4. Press Right  | if Drop & Insert             | Press Left changes EQ 0.6 1.2 1.8 2.4 3.0            |
| 5. Press Right  | goes to Diagnostic Test 1    |  |
| 6. Press Right  | if Line Interface            | Press Left selects CSU Long Haul or DSX-1 Short Haul |
| 7. Press Right  | if CSU Long Haul             | Press Left selects AMI/D4 or B8ZS/ESF                |
| 8. Press Right  | either AMI/D4 or B8ZS/ESF    | Press Left selects Jitter, EGL, LBO                  |
| 9. Press Right  | goes to Diagnostic Test 1    | (if no left press to select Jitter, EGL, LBO)        |
| 10. Press Right | if Jitter                    | Press Left selects Rx or Tx                          |
| 11. Press Right | go to step 8 above           |  |
| 12. Press Right | if EGL                       | Press Left selects 26 or 36                          |
| 13. Press Right | go to step 8 above           |  |
| 14. Press Right | if LBO                       | Press Left selects 00 75 15 22                       |
| 15. Press Right | go to step 8 above           |  |

By pressing <Enter> at any time, you may exit the configuration/diagnostic mode without saving any of your changes. The POST will then resume if it had not been completed at the time you entered configuration/diagnostic mode. If POST had been completed when you entered configuration/diagnostic mode, the download will begin when you exit configuration/diagnostic mode.

To exit the configuration/diagnostic mode and save your changes, cycle the T1 Modem Bank's power off, then on again to return to the initialized state.



## Configuring via the Serial Port Interface

The serial port on the T1 Modem bank can be used to display and modify the T1 configuration. It can also be used to display the installed equipment list, the modem on/off-hook status, and the alarm status. Thus there are 5 basic functions provided by the interface:

1. T1 interface configuration display and modification.
2. Alarm status display.
3. Modem signaling status display.
4. BIOS/NVRAM information
5. Installed equipment information

The T1 modem bank can be configured by a user via a terminal attached to serial port on the modem bank's front panel. This configuration is limited to the following T1 interface parameters:

1. Frame format (D4/SF or ESF)
2. Line Coding (AMI or B8ZS)
3. Jitter attenuation path
4. T1 Robbed-bit signaling protocol
5. Span type (Short- or Long-haul)

There are also some context-dependent parameters that depend on the value chosen for the "Span type" parameter. These context parameters are "Line Build Out", "Receiver Gain Limit" and "Line Length".

To use the interface the user must provide a terminal and connect it to the serial port marked "terminal" on the modem bank's front panel. The cable pinout should follow the standard PC DB-9 serial port pinout.

The interface also implements the XON/XOFF software flow control protocol. <Ctrl-S> may be typed at the attached terminal to interrupt any output from the modem bank to the terminal, and <Ctrl-Q> will cause any paused transmission to resume. The user can use the backspace/erase key to perform limited command line editing when entering commands.

After the Modem bank is powered up and the system firmware downloaded, typically by a host-system OS driver, the modem bank's current T1 configuration will be displayed along with a description of commands that the user may enter.

The initial screen is shown below.

----- Modem Bank Configuration -----				
Parameter	Possible values	<=>selected	[]=active	
1) T1 Frame Fmt.	D4	[ESF ]		
2) Line Coding	AMI	[B8ZS ]		
3) Jitter Attn.	[Transmit ]	Receive	Auto	None
4) T1 Sig. Prot.	GS	LS	[Immediate]	Wink
5) Span Type	[Long ]	Short		
6) Line Build-Out	[0dB ]	-7.5dB	-15dB	-22.5dB
7) Rcv Gain Limit	Low/26dB	[High/36dB]		
-----				

Please enter one of the following

```
-----
C : display T1 configuration   S : store displayed configuration
A : display alarm status      D : display modem switchhook status
B : display system BIOS/NVRAM information,
E : display equipment/revisionlist,
? or H to display this help message,
a number in the range 1 to 7 to change its associated parameter
:
```

## Configuration modification

For each parameter, the currently active value will be shown in square brackets.

Each modifiable parameter has a “selector” number associated with it and displayed on the left margin. For example, the parameter “Span Type” has the selector value 5. From this T1 configuration display, the user can modify any of the displayed parameters by typing in its associated number at the prompt. The user will then be prompted to input a new value for the parameter.

If the parameter is one for which there is a specific enumerated set of values, each possible value will be shown along with a selector number unique to it. The user then selects the value by typing in the selector number and pressing the <Enter> key. Continuing on with the “Span type” parameter as an example, there will be two possible values: long-haul or short-haul. The selector number for long-haul is 1 and the selector number for short-haul is 2.

On the other hand, if the parameter is one with a broad range of possible values, such as line length, then the user is simply asked to enter the new value and finish the selection by pressing the <Enter> key.

When a user modifies a parameter, the change doesn’t take effect until the user enters the command letter “S” to store the new configuration. When any parameter has a value that has been changed from the currently active value, the new but not yet active value will be shown in angle brackets < >. After the new configuration has been stored and made active, this new value will be displayed surrounded by square brackets [ ] and the old and no longer active value will not have any brackets displayed around it.

The user can cancel a change to a parameter by simply pressing the <Enter> key without making a selection and the parameter’s value will remain unchanged.

Here is an example which shows how to change the above configuration from long-haul to short haul:

( user chooses to change the span-type by entering “5” )

```
: 5
The current value for Span Type is Long
The possible values are:
1) Long
2) Short
Hit return to keep the selection unchanged,
or select a number to choose the new value
```

( user selects short-haul for the span-type by entering “2” )

```
: 2
The current value for Span Type has been changed to Short
As a consequence of this change, The Line Build-out and
Receiver Gain Limit parameters have become disabled.
The Line Length Parameter has become enabled. You need
to verify its value.
```

----- Modem Bank Configuration -----				
Parameter	Possible values	<=>selected	[ ]=active	
1) T1 Frame Fmt.	D4	[ESF ]		
2) Line Coding	AMI	[B8ZS ]		
3) Jitter Attn.	[Transmit ]	Receive	Auto	None
4) T1 Sig. Prot.	GS	LS	[Immediate]	Wink
5) Span Type	[Long ]	<Short >		
6) Line Length	133			
-----				

( The user stores the new configuration and makes it “active” by entering “s” )

: s

----- Modem Bank Configuration -----				
Parameter	Possible values	<=>selected		[ ]=active
-----				
1) T1 Frame Fmt.	D4	[ESF	]	
2) Line Coding	AMI	[B8ZS	]	
3) Jitter Attn.	[Transmit ]	Receive	Auto	None
4) T1 Sig. Prot.	GS	LS	[Immediate]	Wink
5) Span Type	Long	[Short	]	
6) Line Length	133			
-----				
:				

### ***Equipment List***

To see a display of installed components with their software and hardware revisions and status, the user types the command letter “e” at the command prompt. There are four component types that can be displayed: motherboard, line card, power supply and modem cards.

The motherboard and linecard components each have an ID byte, a hardware revision and a software revision. There should only be one of each of these two components in a given modem bank.

The power supply component will display whether or not the primary and secondary power supply cards are working and whether or not the secondary card is installed.

Finally, there will be from 1 to 4 modem card components listed. Each of these will have an ID byte and a hardware revision.

An example of the equipment list screen is given below.

```
-----
                          Modem Bank Equipment List
-----

8 components found

slot  type          ID      HW Rev SW Rev
-----

1      Modem Card    0x4D   0
2      Modem Card    0x4D   0
3      Modem Card    0x4D   0
4      Modem Card    0x4D   0

      Motherboard    0x0     15     2.2

      Line Card      0x54    0     1.53

      Power Supply
                        Power Supply 2 is installed
                        Power Supply 1 is not working
                        Power Supply 2 is working
-----
```

## ***System Information***

The user can choose to see a display of modem bank system information.

An example of the system BIOS/NVRAM information screen is given below.

```
-----
                        Modem Bank System Info
-----

Info from NVRAM
-----
EEPROM revision       : 0x1400 B
Node ID               : 1
NVRAM Retrieved Checksum : 0xFFFFF5FF
NVRAM Computed  Checksum : 0xFFFFF5FF

Info from BIOS data area
-----
Memory size           : 2097152
Data cache size       : 2048
Instruction cache size : 4096
EEPROM ID             : 0x1400
EEPROM checksum       : 0xFFFFFFFF
Download rev          : 0x1400
Processor Board ID    : 0
Module ID             : 0
```

### ***Modem Switchhook Status***

The user can choose to see a dynamically updated display of the modem switchhook status for each com port. The screen is updated once per second. A “spinner” will be visible on the left margin to provide a visible heartbeat indicating that updating is in progress. Once started, the display can be canceled by pressing any key.

The display shows the status of all 24 channels, partitioned into four segments of six channels each. These segments correspond to the modem cards.

An example of the Modem switchhook status display is given below.

```
-----
      Modem Bank Signaling Status
-----
      Hit any Key to Cancel Display
      ^=Offhook  -=Onhook  R=Ringin
-----

      Card 1   Card 2   Card 3   Card 4
      000000   000111   111111   122222
      123456   789012   345678   901234
      -   -   -   -
```

^ This is the “spinner” or “heartbeat” indicator.

## Alarm Status

The user can choose to see a continuously updating display of the modem bank's alarm and loopback status. As with the modem switchhook status display, the screen is updated once per second. Also, as with the Modem switchhook status display, "spinner" will be visible on the left margin to provide a visible heartbeat that indicates updating is in progress. Once started, the display can be canceled by pressing any key.

The Received Alarm indication (RcvAlarm) can show one of four values:

1. None
2. Yellow
3. Blue
4. Red

The Transmitted Alarm indication (TxAlarm) can show one of three values:

1. None
2. Yellow
3. Blue

The Signal indication will show one of two values:

1. Present
2. LOS

The Loopback indication will show one of three values:

1. None
2. Line
3. Payload

An example of the alarm and loopback status display is given below. In this case no alarms are in effect and no loopbacks are active.

```
-----
                Modem Bank Alarm Status
-----
                Hit any Key to Cancel Display
RcvAlarm  TxAlarm  Signal  Loopbacks
-----
-   None      None      Present  None
```



An example of the alarm and loopback status display when there are alarms is shown below. In this case no loopbacks are active.

```

-----
Modem Bank Alarm Status
-----
Hit any Key to Cancel Display
RcvAlarm TxAlarm Signal Loopbacks
-----
/ Red Yellow LOS None

```

An example of the alarm and loopback status display when a payload loopback is in effect is shown below.

```

-----
Modem Bank Alarm Status
-----
Hit any Key to Cancel Display
RcvAlarm TxAlarm Signal Loopbacks
-----
| None None Present Payload

```

# T1 Modem Bank Diagnostics

---

The T1 Modem Bank features three methods of running its on-board diagnostic programs:

- **QuickManager mode**
- **display panel mode** The tests are selected and executed by pushing the buttons on the display panel and reading the results on the LED indicators
- **terminal port mode** This mode permits running the diagnostics from a serial terminal using the V key from the debug terminal.

It is easier and less time-consuming to diagnose the T1 Modem Bank using QuickManager than to use the display panel or the terminal port.

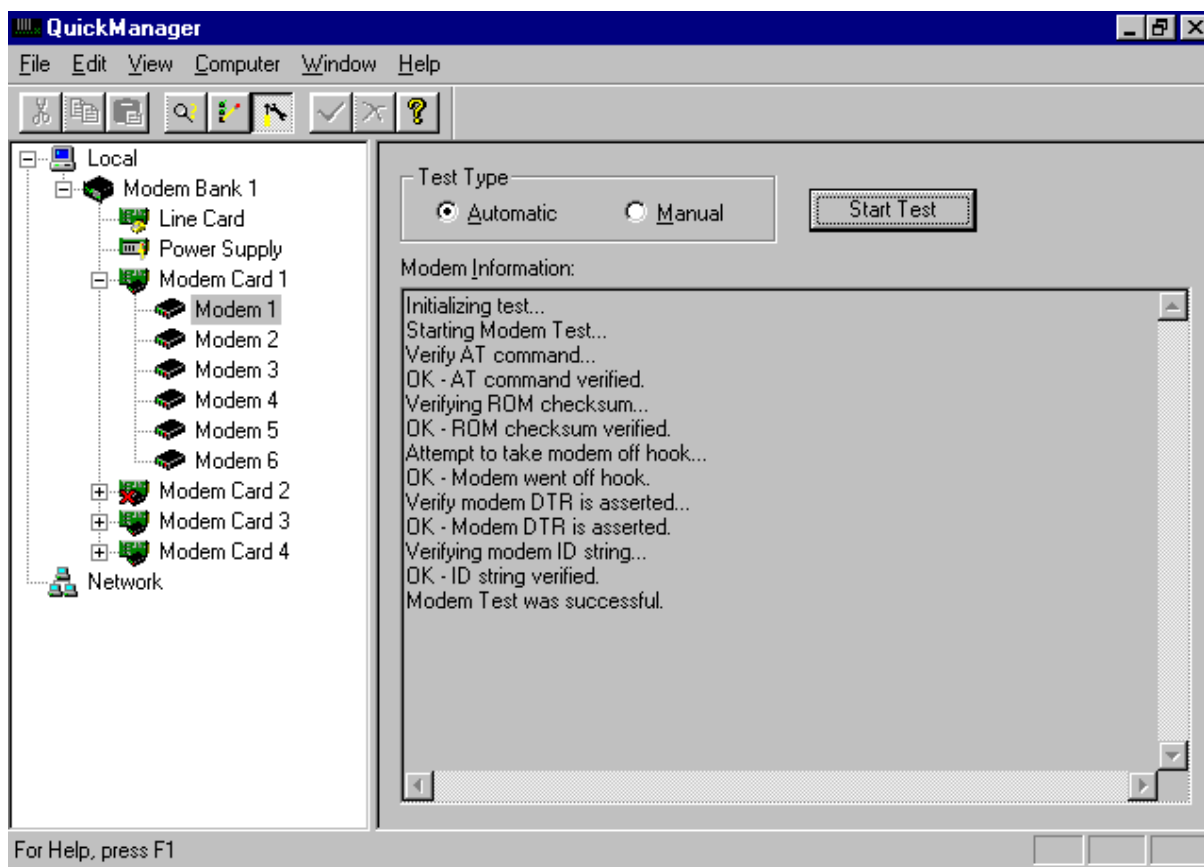
## Running Diagnostics with QuickManager

QuickManager is started by clicking the “Digi” program group, and then clicking the QuickManager icon. Clicking “Window” in the main menu will allow you to view the current configuration settings, change the configuration settings, or run a test on the selected component. (You can alternatively click the applicable button below the main menu).

Figure 21 shows an example screen at the completion of testing Modem 1 of Modem Card 1.

**Figure 21**

**Modem Test Results**



## Running Diagnostics from the Display Panel

To run the internal diagnostic programs from the T1 Modem Bank's front panel, turn the T1 Modem Bank on and wait for the POST (Power On Self Test) to complete. While **P1** is displayed on the front panel, press either button on the display panel.

The first thing you should see is the T1 Modem Bank's node number. This will be displayed in the form **xn**, where **x** is the node number (1n, 2n, and so forth). If you wish to change the node number, press the left push-button repeatedly until the desired node number appears on the display, then press the right push-button to save it in EEPROM. If the new node number is successfully written to EEPROM, **Pn** will be displayed to indicate a pass condition. If the write operation failed, **Fn** will be displayed. See "Setting the Node Number" on page 27 for more information about node numbers.

If you do not wish to change the node number at this time, press the right push-button again to proceed to the Line Card test without rewriting the node number.

If you do not wish to change the line card configuration at this time, press the right push-button again to proceed to diagnostic Test 1 without changing the line card configuration.

Pressing the right push-button repeatedly will cycle through all of the test numbers without executing the tests. To execute a test, press the left push-button while the desired test number is displayed. The left decimal point of the 7-segment display will be turned on to indicate that a test is in progress. Table 4 on page 30 shows the possible codes that could appear in the display panel window when a diagnostic test is performed. Note that codes E0 and E2 through E6 indicate a hard failure. This is a system failure; the test will not continue.

Errors are counted on the ten LED indicators. The error count is a binary number, with the LSB (Least Significant Bit) on the left and the MSB (Most Significant Bit) on the right. Note that in tests 2, 4, 5, 6 and 7, when the test is stopped (by pressing the left push-button), the error count is replaced by diagnostic information. Write down the status of the LED indicators so the information is available in case you need to contact Digi Technical Support.

To stop running a test in progress, push the left push-button again. The test will terminate, and the 7-segment display will show the test number preceded by **P** (pass) or **F** (fail).

To exit diagnostic test mode and return to the initialized state, cycle the T1 Modem Bank's power off, then on again.

# Running Diagnostics from the Terminal Port

1. To run the internal diagnostic programs from the terminal port, turn off the T1 Modem Bank and connect a terminal to the terminal port. Some terminals will not transmit data if their CTS (Clear To Send) line is LOW. These terminals must have their CTS line HIGH or floating to ensure that they will have no problems communicating with the T1 Modem Bank. Appendix C on page 91 shows a cable that can be used for these terminals.
2. Power up the terminal and set its communications parameters to 9600 baud, 8 data bits, no parity and 1 stop bit.
3. Turn the T1 Modem Bank back on and wait for the POST to complete. While P1 is displayed on the front panel, press the letter V (either upper or lower case) on your terminal.

You will see the following screen:

```
Digi International T1 Modem Bank
ROM revision: 0x1400 Rev X [C] Digi International, 1996. All rights reserved
ROM startup (cold boot)
Instruction cache size: 0x00001000
      Data cache size: 0x00000800
      RAM size: 0x00400000
CPU test.....passed
Watchdog test.....passed
ROM checksum test...passed
Simple
RAM test.....0xA0001000-0xA03F0010 passed
Complex
RAM test.....0xA0001000-0xA0002000 passed
Timer test.....passed
Sync test.....passed
Line Card test.....passed
Modem test.....passed
T1 line=AMI/D4 Signaling=AT&T Long Haul Jitter=IN EGL=26 LBO=-22.5
D&I Line=AMI/D4 Signaling=AT&T EQ=0.6
Node number.....1
Press '?' for diagnostics menu
or carriage return to download
```

The results of the POST sequence are displayed, and the T1 Modem Bank begins listening for a ping packet from the EPC/X host adapter. While listening for a ping packet, the T1 Modem Bank cycles through various baud rates and clocking modes as it tries to link up with the EPC/X host adapter. The following messages will scroll continuously until you press ? to get the configuration/diagnostic menu:

```
Listening mode gpp=0x038 mode 15 2400b NRZ ext
...no packet
Listening mode gpp=0x038 mode 60 115kb NRZI clk/16
...no packet
Listening mode gpp=0x038 mode 61 115kb FM0 clk/16
...no packet
Listening mode gpp=0x038 mode 15 2400b NRZ ext
...no packet
Listening mode gpp=0x038 mode 62 230kb NRZI clk/16
...no packet
Listening mode gpp=0x038 mode 63 230kb FM0 clk/16
...no packet
Listening mode gpp=0x038 mode 15 2400b NRZ ext
...no packet
Listening mode gpp=0x038 mode 64 460kb NRZI clk/16
...no packet
Listening mode gpp=0x038 mode 65 460kb FM0 clk/16
...no packet
Listening mode gpp=0x038 mode 15 2400b NRZ ext
...no packet
Listening mode gpp=0x038 mode 66 921kb NRZI clk/16
...no packet
Listening mode gpp=0x038 mode 67 921kb FM0 clk/16
...no packet
Listening mode gpp=0x038 mode 15 2400b NRZ ext
...no packet
Listening mode gpp=0x038 mode 68 1843kb NRZI clk/8
...no packet
Listening mode gpp=0x038 mode 69 1843kb FM0 clk/8
...no packet
```

Press ? to see the configuration/diagnostic menu:

```
---DIAGNOSTIC MENU---
A = All tests (except 9)
1 = Front Panel light test
2 = RAM test
3 = Timer test
4 = Line Card test
5 = Modems test
6 = Sync internal loopback test
7 = Sync external loopback test
8 = EEPROM test
9 = Watchdog test

N = Set concentrator number (currently 1)
L = Line Card configuration
B = Reboot concentrator
d^DD)ump, r^RR)ead, w^WW)rite, f^FF)ill RAM
```

To run individual tests, enter the test number (**1-9**). To run all tests (except number 9), enter A.

Tests run continuously. To stop a test, press any key during execution of the test. The current pass of the test will be completed, and control will be returned to the terminal.

Pressing N allows you to change the T1 Modem Bank's node number.

Pressing L allows you to change the line card configuration.

Pressing B reboots the T1 Modem Bank (similar to a power-on reset, but the diagnostic port remains active).

# Diagnostic Test Descriptions

## Test 1: Front Panel Test

This test activates the ten LED indicators and the two 7-segment displays in four different patterns at 1-second intervals: the first pattern lights the RD, CTS, DCD, RI and IFC LEDs plus the horizontal elements of both 7-segment displays and the decimal point of the second 7-segment display; the second pattern lights all LEDs and display segments; the third pattern lights the TD, RTS, DSR, DTR and OFC LEDs plus the vertical elements of both 7-segment displays and the decimal point of the first 7-segment display; the fourth pattern turns all LEDs and 7-segment displays off. The cycle then repeats. Since the indicators are write only, the operator must visually verify success (or failure) of this test.

To begin the test in front panel mode, press the left push-button while the number **1** is displayed in the 7-segment LED display. While the test is running, the 7-segment display shows the pass count. The test will be repeated until the left push-button is pressed. At this point, **P1** will be displayed. Press the left push-button again to restart the test or the right push-button to advance to Test 2.

When run from a terminal, the test repeats until a key is pressed.

## Test 2: RAM Test

The RAM test performs various walking bit and high bit tests.

RAM tests intermix cached & uncached RAM accesses.

To begin the test in front panel mode, press the left push-button while the number **2** is displayed in the 7-segment LED display. While the test is running, the 7-segment display shows the pass count. Errors are counted on the ten LEDs, and the test is repeated until the left push-button is pressed. At this point, either **P2** (pass) or **F2** (fail) will be displayed. Press the left push-button again to restart the test or the right push-button to advance to Test 3.

When run from a terminal, the test repeats until a key is pressed.

One complete cycle of this test takes about 9 minutes.

## Test 3: Timer Test

The timer test runs the internal timer and verifies that the timer can interrupt the CPU.

To begin the test in front panel mode, press the left push-button while the number **3** is displayed in the 7-segment LED display.

When run from the front panel, the pass number is shown on the 7-segment display. Errors are counted on the ten LEDs, and the test is repeated until the left push-button is pressed. The 7-segment display will then show **P3** or **F3** to indicate pass or fail status.

When run from a terminal, the test repeats until a key is pressed.



## Test 4: Line Card Test

The line card test checks to make sure a line card is installed and working.

To begin the test in front panel mode, press the left push-button while the number **4** is displayed in the 7-segment LED display.

When run from the front panel, the pass number is shown on the 7-segment display. Errors are counted on the ten LEDs, and the test is repeated until the left push-button is pressed. The 7-segment display will then show **P4** or **F4** to indicate pass or fail status.

When run from a terminal, the test repeats until a key is pressed.

## Test 5: Modem Test

The modem test checks to make sure a modem card is installed, and all installed cards are working.

To begin the test in front panel mode, press the left push-button while the number **5** is displayed in the 7-segment LED display.

When run from the front panel, the pass number is shown on the 7-segment display. Errors are counted on the ten LEDs, and the test is repeated until the left push-button is pressed. The 7-segment display will then show **P5** or **F5** to indicate pass or fail status.

When run from a terminal, the test repeats until a key is pressed.

## Test 6: Sync Internal Loopback Test

This test places the high-speed synchronous channel in internal loopback mode. No loopback plug is required to run the test. The internal loopback test checks the 4-wire transmission modes 1, 2 and 60-69. (See Appendix B, beginning on page 89, for a list of the modes).

### *Using Display Panel*

While **6** is shown on the 7-segment LED display, press the left push-button to begin the test. This test runs in internal mode and checks the port in all 12 self-clocking modes (modes 1, 2 and 60-69) of synchronous transmission. All 256 8-bit character values (00h-FFh) are sent in each mode. Errors are counted on the ten LEDs, and the test is repeated until the left push-button is pressed again. At this point, either **P6** (pass) or **F6** (fail) will be displayed. Pressing the left push-button again restarts the test; pressing the right push-button advances to Test 7.

### *Using Terminal*

When running this test from a terminal, you are first asked for the transmission mode (0-74). Enter the mode number you wish to test, or press <Enter> to test all modes. (Note that only modes 1, 2 and 60-69 are checked by this test. See Appendix B, beginning on page 89, for a list of the modes). Next, you are asked for the data to send (00h-FFh). Enter the hexadecimal value to send, or press <Enter> to use all 8-bit values.

## Test 7: Sync External Loopback Test

This test places the high-speed synchronous channel in external loopback mode. In video mode, this test can be run with or without an external loopback cable. The external loopback test checks the internally clocked and self clocked transmission modes (0-2, 6-14, 27-29 and 60-74). (See Appendix B, beginning on page 89, for a list of the modes).

### *Using Display Panel*

While 7 is shown on the 7-segment LED display, press the left push-button to begin the test. This test runs in external mode and checks the port in all 12 self-clocking and internally clocked modes (0-2, 6-14, 27-29 and 60-74) of synchronous transmission. All 256 8-bit character values (00h-FFh) are sent in each mode. Errors are counted on the ten LEDs, and the test is repeated until the left push-button is pressed again. At this point, either P7 (pass) or F7 (fail) will be displayed. Pressing the left push-button again restarts the test; pressing the right push-button advances to Test 8.

## Test 8: EEPROM Test

This test generates a checksum of the EPROM contents and compares it with the checksum stored in the EEPROM. If the checksums match, the test passes. This test does not write to the EEPROM. (EEPROM write operations occur only when a new node number is set). To begin this test in display panel mode, press the left push-button while 8 is displayed. Errors are counted on the ten LEDs, and the test is repeated until the left push-button is pressed again. At this point, either P8 (pass) or F8 (fail) will be displayed. Pressing the left push-button again restarts the test; pressing the right push-button advances to Test 9.

## Test 9: Watchdog Test

This test checks out the watchdog timer. This is a hardware feature that is used to ensure system reliability. When the watchdog timer is loaded and enabled, the timer begins counting down. It is up to the system to keep reloading the timer to prevent it from expiring. Normal test execution allows the timer to expire, then the test is repeated. The test fails if the timer has not expired after 1 second. To begin this test in display panel mode, press the left push-button while 9 is displayed. Errors are counted on the ten LEDs, and the test is repeated until the left push-button is pressed again. At this point, either P9 (pass) or F9 (fail) will be displayed. Pressing the left push-button again restarts the test; pressing the right push-button advances (wraps around) to the node number.

# Component Removal and Installation

---

This section provides replacement instructions for various components. The line card, modem card, power supply, fan assembly, and fuse may be replaced by any on-site personnel of average skill. However, the ribbon cable, sync and terminal cable, and power inlet filter **must** be replaced at the factory.

Table 6 lists the various components that may need to be replaced, the required skill level, and where more detail is provided.

**Table 6** **Component Level Troubleshooting**

Component	Skill Level Required for Field Installation	Reference
Line Card	Operator	Line Card Removal and Replacement on page 66
Modem Card	Operator	Modem Card Removal and Installation/Replacement on page 68
Power Supply	Operator	Power Supply Removal on page 73 Power Supply Installation/Replacement on page 8
Fan Assembly	Operator	Fan Assembly Removal and Replacement on page 75
Fuse	Operator	Fuse Replacement on page 76

# Line Card Removal and Replacement

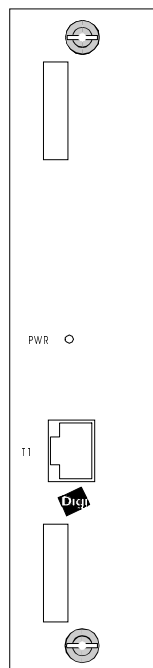
These instructions are provided in the event that the line card needs to be replaced in the field due to equipment malfunction. If the line card is malfunctioning, a message number E6 will flash in the display panel window or the boot will not proceed past the D0 state.

## **Important!**

The T1 Modem Bank must be powered down before the line card is removed and replaced since the card does **not** have hot swap capabilities. Use the OFF/ON switch in the rear of the chassis. The PWR light will be unlit when the unit is turned off.

Figure 22

Line Card



## **Note:**

Wear a grounding strap during this procedure to prevent electrical discharge.

The line card is located on the left as you face the front of the chassis. It is accessed from the front of the chassis. A power indicator LED and a T1 jack are part of the line card faceplate. Follow this procedure to replace the line card:

1. Label, then remove the T1 line.
2. There are two captive fasteners that secure the line card to the chassis. To remove the malfunctioning line card, use a flathead screwdriver to loosen the captive fasteners on the malfunctioning line card. Pull the ejector levers, then slide the malfunctioning line card out of the chassis.
3. To install the replacement line card in the slot, turn the card so the card edge faces the back plane, and the LED and RJ48 connectors face outward, toward the front of the chassis. The slot in the chassis contains a card guide; the card should be inserted so the RFI fingers are on the left of the card guide. Slide the new card into the slot and push in firmly until the card seats with the back plane receptacle.
4. Finger-tighten the two captive fasteners on the line card. Each fastener must be properly aligned; it could be stripped if not correctly threaded into the receptacle. To better secure the line card, tighten the two captive fasteners using the screwdriver.

# Modem Card Removal and Installation/Replacement

## Modem Card Removal

Modem cards can be “hot swapped”, meaning that no system reset is needed after a modem card is pulled out and replaced with another modem card. This does not mean that modem boards should be moved from slot to slot without cause, since the motherboard senses and stores information regarding a modem board’s correct location.

### **Important!**

- Do not remove a modem card for any reason when the activity LEDs labeled ONL1-ONL6 are lit. These LEDs indicate the card is in use or “off-hook”.
- Wear a grounding strap during this procedure to prevent electrical discharge.
- The T1 Modem Bank will “busy out” unavailable lines if fewer than four modem cards are installed in the card cage.
- The maximum number of modem cards that can be installed is four. The faceplate next to the line card is blank because a modem card can not be installed in this location. Blank faceplates can also be installed over any of the four possible modem card locations which do not contain modem cards.



Modem cards are located on the front of the chassis between the line card (labeled T1 and PWR) and the sync and terminal connections (labeled HOST IN, HOST OUT and TERMINAL). Six on-line indicators and one power indicator are found on the modem card faceplate. Refer to Figure 1 on page 1 for an overall view of the T1 Modem Bank.

Follow this procedure to replace a modem card:

1. Determine which modem card needs to be replaced. This will be indicated by running POST, using QuickManager, or observing the display panel window after the FEP/OS is loaded. There are two types of modem cards, and they can be interchanged in any way you want in your system. Table 7 illustrates the revision numbers and the differences between the types of modem cards.

**Table 7** **Types of Modem Cards**

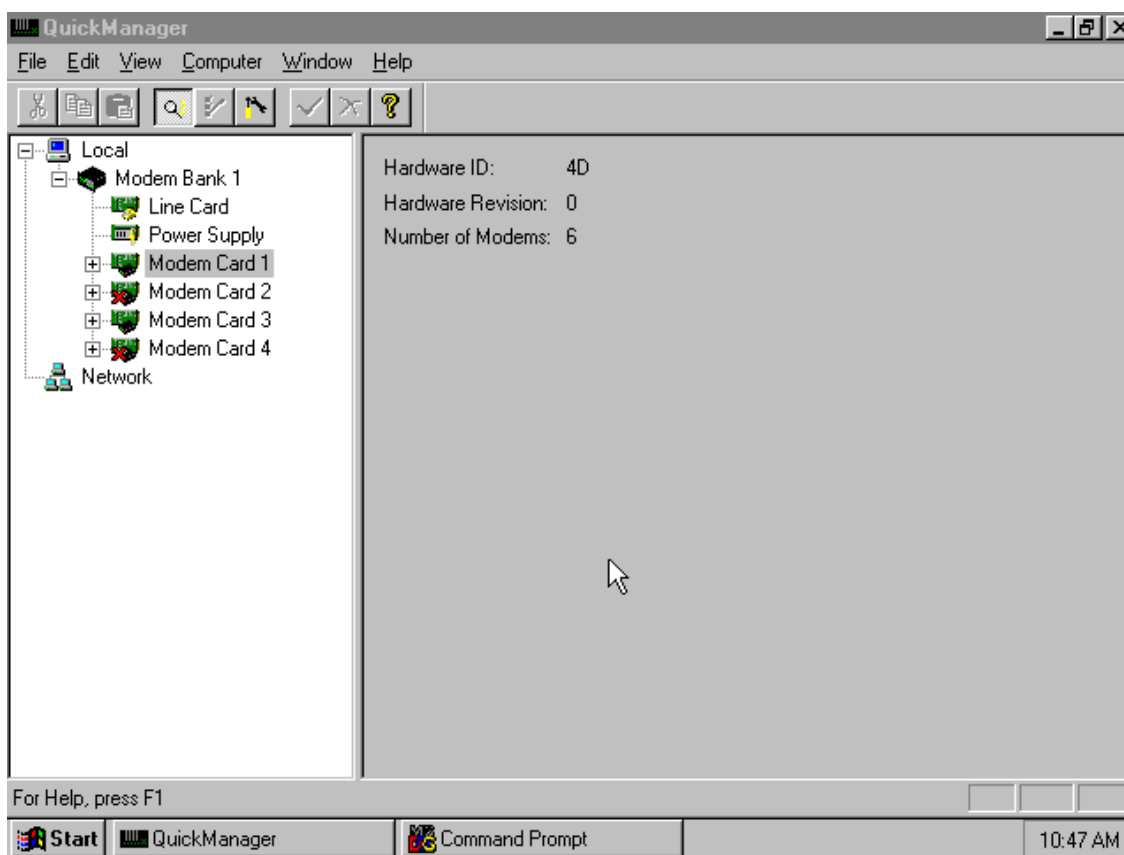
Modem Revision	Description
0	V.34 compliant modem. Connection rates as high as 28.8kbps. No new modem flash upgrades.
1	V.34 compliant modem. Connection rates as high as 33.6kbps. Modem flash upgrades are allowable when they are available.

QuickManager will allow you to identify the revision of each modem card in your system. Figure 24 is an example screen showing that modem card 1 in this particular system has a revision of 0.



Figure 24

Quick Manager Modem Revision Screen



2. There are two captive fasteners that secure the modem card to the chassis. To remove the modem card, use a flathead screwdriver to loosen the captive fasteners on the malfunctioning modem card. Pull the ejector levers, then slide the malfunctioning modem card out of the chassis.

## Modem Card Installation/Replacement

This section describes how to install an additional modem card or to replace a modem card that has been removed. Modem cards can be “hot swapped”, meaning that no system reset is needed after a modem card is pulled out and/or installed. This does not mean that modem boards should be moved from slot to slot without cause, since the motherboard senses and stores information regarding a modem board’s correct location.

### **Important!**

Wear a grounding strap during this procedure to prevent electrical discharge.

Perform the following steps to install a modem card:

1. Before installing an additional modem card into an empty slot, you must remove the faceplate covering the slot. Loosen the captive screws from the faceplate using a flathead screwdriver and lift off the faceplate.
2. To install the modem card in an empty modem slot, turn the modem card so the card edge faces the back plane and the LEDs face outward, toward the front of the chassis. The slot in the chassis contains a card guide; RFI fingers on the card should be on the left side of the card guide. Slide the modem card into the slot and push firmly until the card seats with the back plane receptacle.
3. Finger tighten the two captive fasteners on the modem card. Note that each fastener must be properly aligned; the fasteners could be stripped if they are not correctly threaded into the receptacle. To better secure the modem card, tighten the two captive fasteners using the flathead screwdriver.
4. After installation, the power LED (marked PWR) on the modem card will be lit.

# Power Supply Removal

There are two ways to check a power supply failure:

- Use QuickManager
- Check the LED on the power supply's printed circuit board. An unlit LED indicates that the power supply has failed.

## **Important!**

- Wear a grounding strap while performing the following procedure to prevent electrical discharge.
- Avoid touching the fan during the following procedure since the fan blade could cause harm.

1. If dual power supplies are installed in the unit, determine which power supply is malfunctioning. Because dual power supplies feature a load redundant hot swap scheme, the malfunctioning power supply can be removed without powering down the unit.

## **Important!**

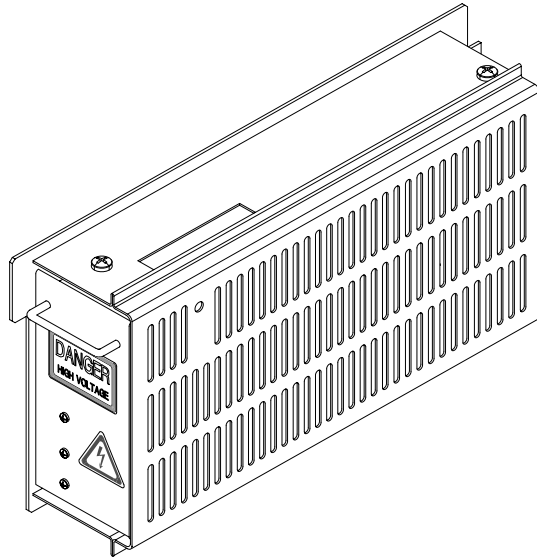
If the T1 Modem Bank has only *one* power supply installed, use the ON/OFF switch at the back of the T1 Modem Bank to power-down before removing the power supply.

2. Loosen the two captive screws on the display panel faceplate; carefully pull down the hinged display panel faceplate to access the power supply (or supplies).

## **Important!**

When handling the power supply printed circuit board, do not touch the edge connector that connects to the distribution board because damage to the board may result.

3. Pull out the malfunctioning power supply from the chassis.
4. See "T1 Modem Bank Power Supply Installation/Replacement" on page 8 for instructions on installing/replacing a power supply.



# Fan Assembly Removal and Replacement

If the T1 Modem Bank overheats or exceeds its operating range, the fan is probably malfunctioning. If this is the case, follow the procedure below.

## **Important!**

Wear a grounding strap while performing these procedures to prevent electrical discharge.

1. Loosen the two captive screws on the display panel faceplate; carefully pull down the hinged display panel faceplate to access the fan assembly.
2. The fan assembly consists of a fan mounted on a card guide. Look into the chassis and observe the fan assembly while the power is on. An unlit LED on the fan assembly indicates the fan is malfunctioning or the fuse is blown.
3. Turn off the T1 Modem Bank using the power switch on the rear of the unit.
4. Slide the malfunctioning fan assembly out of the chassis.
5. Slide the replacement fan assembly into the chassis.

## **Important!**

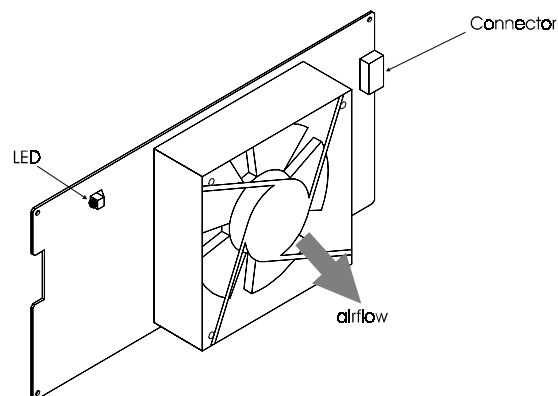
- Make sure the fan assembly is installed so that the airflow will exit the chassis.
- Make sure the fan assembly is seated with the connector on the AC distribution board.

See Figure 26.

6. Push up the hinged display panel faceplate and tighten the two captive screws.

**Figure 26**

**Fan Assembly**

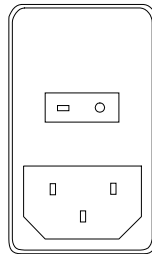


# Fuse Replacement

A defective fuse is indicated by a total loss of power to the system. The fuse is located at the rear of the unit behind the AC power inlet filter. A diagram of the AC power inlet filter is shown below.

**Figure 27**

**AC Power Inlet**



## **Important!**

Wear a grounding strap during this procedure to prevent electrical discharge.

Follow this procedure to replace a fuse:

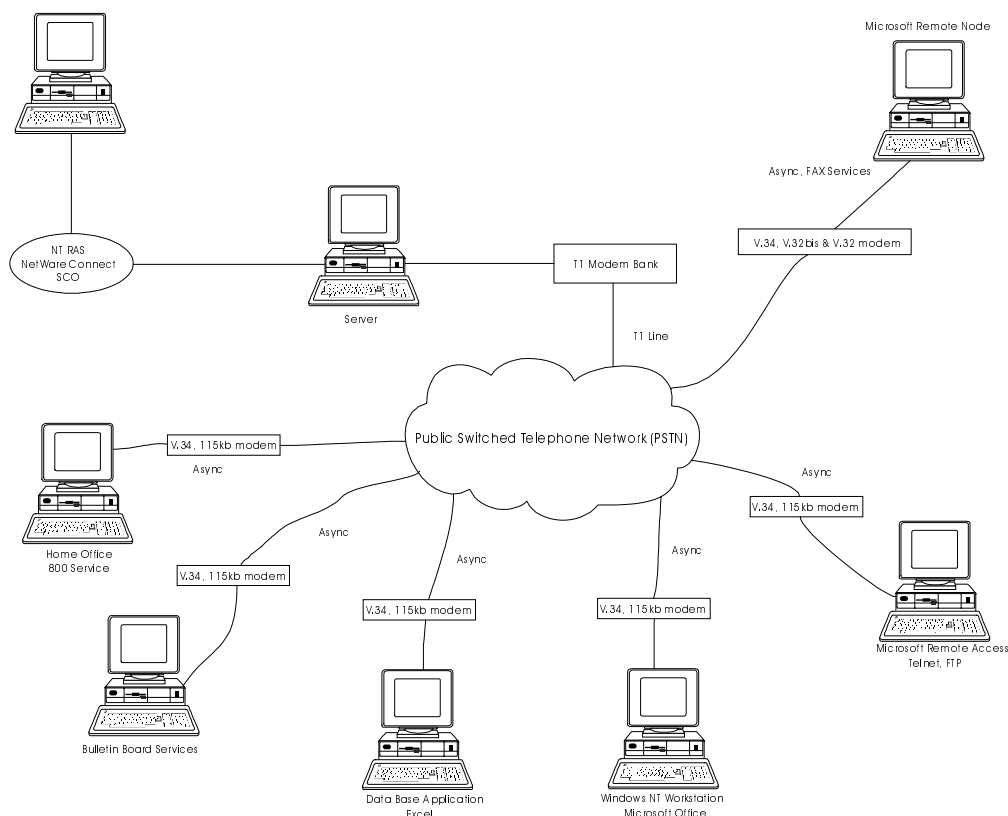
1. Turn the T1 Modem Bank's power switch at the rear of the unit to the OFF (●) position.
2. With a small screwdriver or knife, pry open the lid covering the fuse. The receptacle has two slots into which an AGC6 250V, 3A fuse used for domestic installations can be inserted.
3. Replace the fuse.
4. Slide the fuse receptacle back into the unit, and replace the lid.

# Connections to the Telephone Network

Figure 28 illustrates connections to the PSTN (Public Switched Telephone Network) using the T1 Modem Bank. With PSTN, a modem modulates serial data into voice-like signals for transmission. At the receiving end of a circuit, or connection, another modem demodulates the information, converting it back to serial data. Note that various applications—such as 800 services, bulletin board services, the World Wide Web, and FAX services—can be accessed via the PSTN and long distance service.

The T1 Modem Bank provides an excellent resource for Remote Access Services (RAS). RAS enables users to remotely dial-in to a local office and upload/download files for applications. The remote PC connects to the server via V.34, V.32bis, and V.32 asynchronous modems. TELNET, FTP, and PPP connections between remote offices and a local office can also be made.

**Figure 28** T1 Modem Bank and Public Switched Telephone Network



## Alarms on a T1 Span

Alarm	Reason for Alarm	Result of Alarm
Red Alarm	The T1 Modem Bank is not receiving a valid signal from the T1 Line.	The T1 Modem Bank sends a “Yellow Alarm” down the T1 line, and it will not accept calls or dial out.
Yellow Alarm	The Central Office was in a Red Alarm state (i.e., it can’t hear you). The alarm goes away approximately 15 seconds after the Red Alarm clears itself.	The T1 Modem Bank can not accept calls or dial out on the T1 line.
Blue Alarm	Keep-alive signal from the T1 Line. Remote CSU is generating it, or an improper supervision mode (signaling) was chosen.	The T1 Modem Bank can not accept calls or dial out on the T1 line.

## T1 Modem Bank Interaction

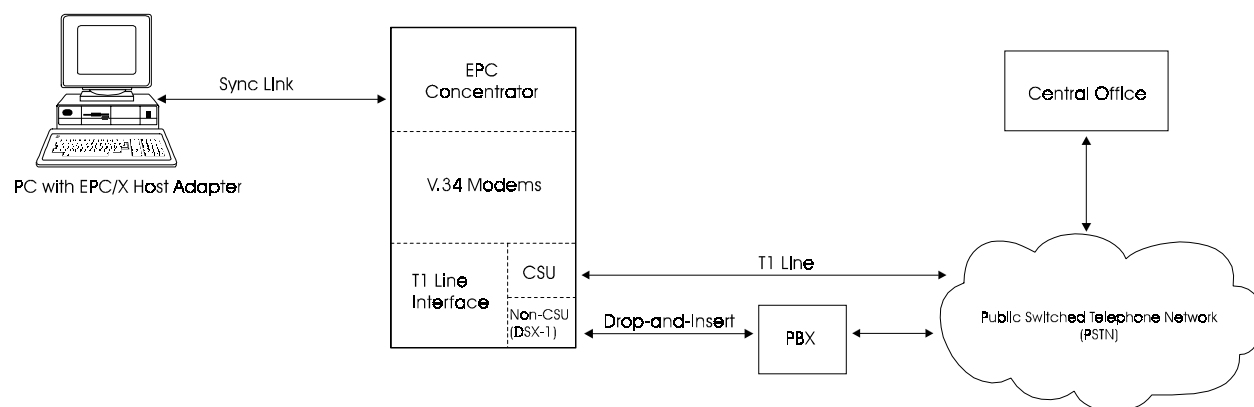
Interaction takes place between the PSTN, the T1 Modem Bank, and the PC containing the EPC/X host adapter.

Figure 29 shows the major components of the T1 Modem Bank and the connections between them. An EPC sync link interconnects an EPC/X host adapter and an EPC concentrator. (The EPC/X host adapter plugs into a slot in a computer’s interface bus.) Data is then transmitted via V.34 modems to a T1 Line interface, which in turn sends the data to the T1 line. This occurs using a T1 line in either CSU mode or non-CSU DSX-1 mode.

- **CSU mode** can transmit data on a T1 line over distances from 0 to 6,000 feet, without a repeater, using 22 AWG twisted-pair cable.
- **Non-CSU DSX-1 mode** transmits to a PBX only over short distances, up to 655 feet, with receive jitter attenuation.

**Figure 29**

**Functional Block Diagram of the T1 Modem Bank**





# Physical Specifications

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## T1 Modem Bank Power Cord Specifications

The chassis has a 3-wire power cord. The free end of the 3-wire power cord connects to the 110 VAC (domestic) power source and protective ground. NEMA plug type 5/15P is used for US installations.

The North American cordset is rated 15A/125V, and is UL/CSA approved.

### **Note:**

A T1 Modem Bank sold in North America is shipped with a standard power cord. Units sold outside of North America are shipped without a power cord. If the power cord needs to be replaced, or if you need to purchase an original power cord, use only a cord that meets the following specifications:

Type: SJT or SVT flexible power cord, compatible with an IEC320 appliance inlet.

Safety Approvals:

The cord must bear the mark of the agency in your country (such as UL, CSA, VDE, SEMKO, and so on).

Temperature Rating:

75°C minimum

Voltage Rating:

125 Volts minimum (North America)

Current Rating:

15 Amps maximum

Conductor Size:

3 x 18 AWG or 3 x 0.75 mm, or larger

For power cord selection in Germany, use only a H05VV-F, <HAR>, VDE, PVC, 3 x 0.75mm power cord.

Für gebrauch in Deutschland muß ein Netzkabel des typs H05VV-F, <HAR>, gröÙe, 3 x 0.75mm verwendet werden.

# T1 Modem Bank Environmental Requirements

The T1 Modem Bank meets all functional requirements in this manual when operating in the environment listed below:

Ambient Temperature	0° C to 40° C
Relative Humidity	5% to 90%, non-condensing
Altitude	0 to 12,000 feet

## T1 Modem Bank Rack Specifications

The specifications listed below apply to both standalone units and rack-mounted units.

Depth	13.0132inches
Height	6.930 inches
Weight	32 lb. fully loaded
Width	17.048 inches

### Standalone Unit Specifications

Width	17.048 inches
-------	---------------

### Rack Specifications

The T1 Modem Bank rack systems are enclosed in either a 19" or 24" rack.

#### ***4U 19 Inch Rack System***

Width	19.000 inches (with mounting brackets for rack installations)
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#### ***4U 24 Inch Rack System***

Width	24.000 inches (with mounting brackets for rack installations)
-------	---

# Daisy Chain Cables

Daisy Chain cables have the following attributes:

- Twisted pair, overall shield, 28 AWG
- Capacitance  $15.5 \pm 3$  pF/ft.
- Impedance 100  $\Omega$ /ft.
- Belden 8-wire (4 twisted pair) #9806, or Belden 4-wire (2 twisted pair) #9804 HD-15 subminiature connectors, 1 male (AMP #748364-1 or equivalent; contacts: size 22 male AMP #748333-5 (or equivalent)), and 1 female (AMP #748565-1 or equivalent; contacts: size 22 female AMP #748610-2 (or equivalent))
- Digi part number 62110018 (18")

# Terminator Plug

Terminal plugs have the following attributes:

- HD-15 subminiature male plug (AMP #748364-1) or equivalent
- Contacts: size 22 male (AMP #748333-5 or equivalent) with the following pairs of pins wired together: 1-6, 2-7, 3-15, 4-9, 5-10, 8-14
- Digi part number 60000388

# T1 Loop Back Plug

- RJ45 8P/8C hone plug
- Pins wired together: 1-4, 2-5
- Digi part number 63000001-01

# T1 Modem Bank Certification

The T1 Modem Bank is certified to meet the following electromagnetic emissions and safety standards:

## **Emissions:**

USA: FCC Part 15, Subpart J, Class A

Canada: CSA C108.8-M83, Class A

Cispr 22, Class A EN55022

## **Safety:**

USA: UL 1950

Canada: C22.2 No. 950

## **Telecom:**

USA: FCC part 68

Canada: ICCS 003

# Glossary

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**AMI** (Alternate Mark Inversion) — a line coding method for T1 spans.

**bandwidth**— the difference between the highest and lowest frequencies in a given range; the maximum data-carrying capacity of a circuit. (Greater bandwidth indicates higher speed data-transfer.)

**B8ZS** (Binary 8-Zero Suppression) — a line coding method for T1 spans

**channel** — an increment of bandwidth provided by the WAN.

**channel bank** — a voice time division multiplexer.

**CSU** (Channel Service Unit) — the interface to the T1 line that terminates the local loop.

**Drop-and-insert** —a service feature where some number of DS0s are passed through the T1 Modem Bank to other telephone equipment, usually a PBX. The remaining DS0s terminate at the T1 Modem Bank.

**DS-0** (Digital Signal Level 0)— a 64K bps channel, the world-wide standard speed for PCM digitized voice channels.

**DS-1** (Digital Signal Level 1)— in North America, a 1.544M bps data stream composed of 24 DS0 channels. A DS1 is provided on T1 transport facilities.

**DSX-1** (Digital Signal Cross Connect, Level 1) — part of the DS-1 specification.

**DTMF** (Dual Tone Multi Frequency)—touch-tone dialing

**E&M** — Signaling leads on a voice tie line; known as “Ear and Mouth.” Types I and II are most common in the US.

**EPC/X** (Enhanced Performance Concentrator)

**ESF** (Extended Super Frame) — ESF is based on ANSI T1.403 or AT&T Pub 54016.

**flow control** — a mechanism for limiting the amount or rate of data sent by a transmitting entity to avoid congestion in the network or the receiving device.

**ground start** — T1 supervision and signaling method

**ISO** (International Standards Organization)— a voluntary, independent organization chartered to define international standards for communications of all types.

**ISO model** (More completely, the *ISO model for Open Systems Interconnection*) — This is the model of computer communications that has seven layers. The ISO model describes the ISO OSI communications architecture. ISO communications standards fit into several places in this model.

**jitter** — short term variations in the rate at which data arrives on the T1 span. Jitter is removed by means of a “jitter attenuator” which is present in the T1 Modem Bank.

**LAN** (Local Area Network) — a communications architecture that passes information between multiple systems over relatively short distances at high speeds

**line** — the physical interface to the WAN.

**LBO** (Line Build Out) — Insertion of loss in a short transmission line to make it act like a longer line

**Loop-Start** — T1 supervision and signaling method

**modem** (*Modulator-demodulator*)— a device for modulating a carrier with a data stream ready for transmission and demodulating or extracting a data signal from a received signal.

**network** — a collection of links, nodes, and computers that provide connections between two or more defined points to facilitate telecommunication between them.

**off-hook** — the modem is in use, and the activity light is on.

**PCM** (Pulse Code Modulation) — the standard digital voice format, at 64K bps;

**POP** (Point-of-Presence) — the point within a local TELCO where the subscribers' circuits for leased-line or long distance dialup circuits are terminated.

**PPP** (Point-to-point protocol) — a communication link in which two stations are directly connected. PPP allows for TCP/IP connections over serial lines and serial devices such as modems.

**Private or leased lines** — refer to a permanent circuit between endpoints over which data is transmitted. Private or leased circuits are available from providers of WAN digital communications. T1 lines can be supplied by the provider to include private or leased circuits and others such as switched lines.

**Protocol** — a set of rules or standards designed to enable computers to connect with one another and exchange information with as few errors as possible.

**PSTN** (Public Switched Telephone Network)

**Robbed bit signaling** — a bit in the data stream used for signaling

**switched line** — a single-circuit line connection between two points on a switched network. This is usually a connection made as a result of dialing via the phone system, as opposed to a permanent leased line.

**TCP/IP** (Transmission Control Protocol/Internet Protocol) — a set of network services that provides interoperability between heterogeneous systems. The TCP portion is responsible for providing reliable and recoverable communications between two end points. The IP portion sets up the routing used by TCP to transmit.

**TELCOS** — TELEphone COmpanies

**T1** — a digital transmission method for multiplexing multiple voice and/or data channels over a system of copper wire cables with amplifiers or regenerators that reinforce the digital signal at intervals of about one mile. T1 offers a two-way connection at 1,544,000 bits per second. One T1 line carries a DS1 circuit, the equivalent of 24 port connections running at 64K bps. Depending upon the provisioning by the carrier, both leased channels and switched channels may be combined. Point-to-point dedicated T1 lines provide only permanent circuits. Switched T1 lines commonly use in-band signaling for call management, resulting in switched 56K bps channels.

**UART** (Universal Asynchronous Receiver/Transmitter) — a device that performs asynchronous communication functions by converting parallel digital output from a DTE device into serial bit transmission and vice versa.

**virtual circuit** — a communications link that appears to be a direct connection between sender and receiver, although the link can physically involve routing between a more circuitous path.

**Wide-Area Network (WAN)** — a network composed of systems that are relatively far apart, meaning that the area is usually gauged in hundreds of miles. A WAN may also encompass a series of LANs connected over a wide area.

**Note:**

In this manual, WAN refers to a network consisting of lines provided by telephone companies.

**wink start** — in placing a call, the T1 Modem Bank goes off-hook, then waits for a wink acknowledgment before dialing.

# Appendix A — Memory Conflicts

---

## Contention for Memory Addresses

Many intelligent peripheral devices require a block of vacant memory addresses on the host computer's bus for their own use. These memory addresses may be used to access a dual-ported RAM on the peripheral device to facilitate the transfer of large volumes of data between the host and the peripheral (memory-to-memory transfers are much faster than I/O bus transfers), or they may point to a ROM BIOS (a firmware program used by the host computer to control the peripheral device). In either case, the host computer sees this memory as its own, and can use the same high-speed memory-referencing commands that it uses with its internal memory.

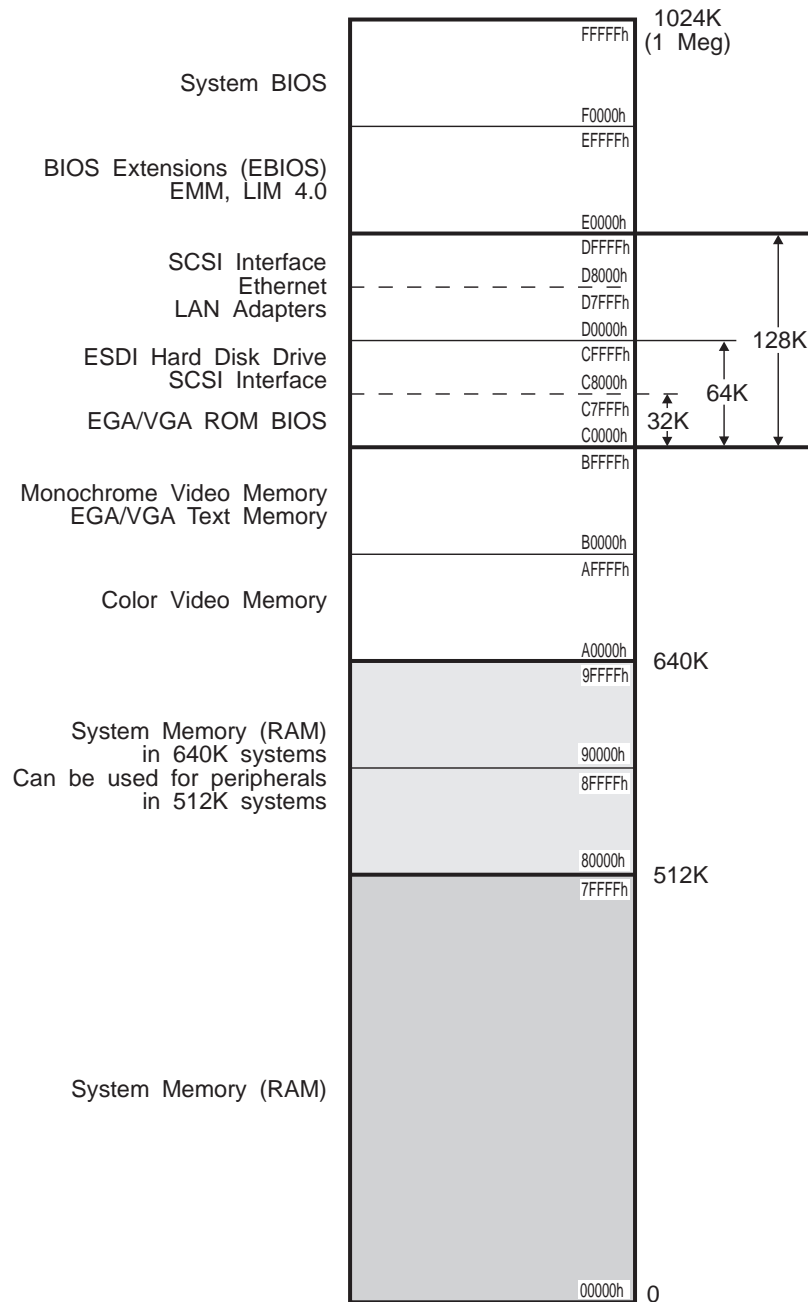
Figure 30 on the following page shows a map of the first megabyte of a host system's memory bus. The shaded areas represent the computer's internal RAM (nearly always 640K, but can often be reduced to 512K—there is also usually more RAM above the 1 Meg boundary). The area between the RAM and the 1 Meg boundary is used for the host system's BIOS, option ROMs and peripheral memory. The memory map shows the locations typically used by some of the most common peripheral devices.

### **Note:**

The memory map on the following page shows typical memory usage. To be certain of what areas are available in your system, you will need to consult the documentation for your computer and peripheral devices.

Figure 30

Typical PC Memory Usage - 1st Megabyte





## ISA Host Adapters

The Digi ISA EPC/X host adapter has 1 megabyte of on-board dual-ported RAM which is accessed through a 32K “window”, which can be mapped into any 32K region in the computer’s memory address space (32K byte boundaries end with either 0000h or 8000h). The dual-ported RAM can also be mapped in its entirety into the host computer’s memory address space on any 1 megabyte boundary below 16MB—this option will be supported in some future device driver software releases.

Current Digi device drivers support sixteen preconfigured 32K address ranges for ISA host adapters, beginning at 80000h, 88000h, 90000h, 98000h, A0000h, A8000h, B0000h, C8000h, C0000h, C8000h, D0000h, D8000h, E0000h, E8000h, F0000h or F8000h. These addresses are all below the 1 megabyte boundary. In practice, only four of these address ranges are likely to be available. The addresses E0000h-FFFFFh are typically used for the system BIOS and BIOS extensions; the addresses A0000h-BFFFFh are used for video buffers, and the addresses 80000h-9FFFFh are between 512K and 640K, and so can only be used with host computers having no more than 512K of base memory (memory below 1 megabyte). Since most computers have 640K of base memory, only the addresses from C0000h-DFFFFh are generally usable. To complicate matters, most intelligent peripheral devices require some memory address space in this region for their ROM or shared memory. It is therefore necessary to insure that the memory address range chosen for the ISA host adapter does not conflict with the range used by any other device in your system.

Some typical sources of contention are:

- Plug-in VGA and EGA cards, which have a ROM BIOS beginning at C0000h.
- ESDI hard disk controllers, which typically have a ROM BIOS beginning at C8000h or CC000h.
- SCSI interfaces, which have a ROM BIOS that may be located anywhere in the C0000h-DFFFFh range.

Consult the documentation for your peripheral devices to determine what (if any) memory addresses they may be occupying on the host memory bus.

## Conflicts Between 8-Bit and 16-bit Memory Devices

The ISA (Industry-Standard Architecture) bus, used in 80286 (AT compatible) and 80386 based computers, supports 16-bit memory and peripherals with 16-bit dual-ported memory or ROM. By default, however, memory devices are considered to be 8-bit devices. 16-bit devices must declare themselves by raising a flag, so that the host knows whether it is referencing a byte (8 bits) or a word (16 bits) of memory.

Memory addressing on the ISA bus consists of 2 phases: First the unlatched address bits (bits A17 to A23) are placed on the bus. Then the latched bits (A00 to A16) are placed on the bus. A 16-bit device must declare itself after the unlatched bits go on the bus, but before the latched bits go out. Since the unlatched bits can only resolve 128K blocks of memory (e.g. 080000h-09FFFFh, 0A0000h-0BFFFFh, 0C0000h-0DFFFFh), the presence of any 16-bit device in a 128K segment causes the entire segment to be treated as 16-bit memory. Thus if an 8-bit device resides in the same 128K block as a 16-bit device, only even-numbered bytes will be accessible, and the device will fail.

The ISA EPC/X host adapter is a 16-bit board.

## EISA Host Adapters

The Digi EISA EPC/X host adapter has 1 megabyte of on-board dual-ported RAM which is accessed through a 32K “window”, which can be mapped into any 32K region in the computer’s memory address space up to the 4 gigabyte limit. The EISA EPC/X configuration file provides sixteen address ranges below 1 megabyte, and sixteen address ranges in the fourth gigabyte:

***Below 1 Megabyte:\****

80000h	88000h	90000h	98000h
A0000h	A8000h	B0000h	B8000h
C0000h	C8000h	D0000h	D8000h
E0000h	E8000h	F0000h	F8000h

***Above 1 Megabyte:***

F0000000h	F1000000h	F2000000h	F3000000h
F4000000h	F5000000h	F6000000h	F7000000h
F8000000h	F9000000h	FA000000h	FB000000h
FC000000h	FD000000h	FE000000h	FF000000h

\* When addressed below 1 megabyte, the same constraints apply as for the ISA host adapter (see page 87).

# Appendix B — Transmission Modes

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The EPC/X host adapter and the T1 Modem Bank transmit synchronous data in one of 75 modes. These modes are numbered 0 - 74, and each corresponds to a specific combination of wiring mode (4-Wire or 8-Wire), clocking method (internal, external or self-clocking) and baud rate. The 75 modes and their definitions are listed below:

## 8-Wire, Internally Clocked

Mode#	Mode	Baud Rate	Mode#	Mode	Baud Rate
0	NRZ	115K	13	NRZ	921K
3	NRZ	2400	14	NRZ	1229K
4	NRZ	4800	27	NRZ	1843K
5	NRZ	9600	28	NRZ	2458K
6	NRZ	19200	29	NRZ	3686K
7	NRZ	38400	70	NRZ	1843K
8	NRZ	57600	71	NRZ	2458K
9	NRZ	76800	72	NRZ	3686K
10	NRZ	115K	73	NRZ	7373K
11	NRZ	230K	74	NRZ	10M
12	NRZ	460K			

## 8-Wire Synchronous Modem (External Clock)

Mode#	Mode	Baud Rate	Mode#	Mode	Baud Rate
15	NRZ	2400	35*	NRZ	2400
16	NRZ	4800	36*	NRZ	4800
17	NRZ	9600	37*	NRZ	9600
18	NRZ	19200	38*	NRZ	14400
19	NRZ	38400	39*	NRZ	19200
20	NRZ	57600	40*	NRZ	38400
21	NRZ	76800	41*	NRZ	57600
22	NRZ	115K	42*	NRZ	64111
23	NRZ	230K	43*	NRZ	76800
24	NRZ	460K			
25	NRZ	921K			
26	NRZ	1229K			
30	NRZ	1843K			
31	NRZ	2458K			
32	NRZ	3686K			
33	NRZ	14400			
34	NRZ	115K			

\* Modes 35-43 are for RS-232 synchronous modems; modes 15-34 are for RS-422 synchronous modems.

#### 4-Wire, Self Clocked

Mode#	Mode	Baud Rate	Mode#	Mode	Baud Rate
1	NRZI	230K	64	NRZI	460K
2	FM	460K	65	FM	460K
60	NRZI	115K	66	NRZI	921K
61	FM	115K	67	FM	921K
62	NRZI	230K	68	NRZI	1843K
63	FM	230K	69	FM	1843K

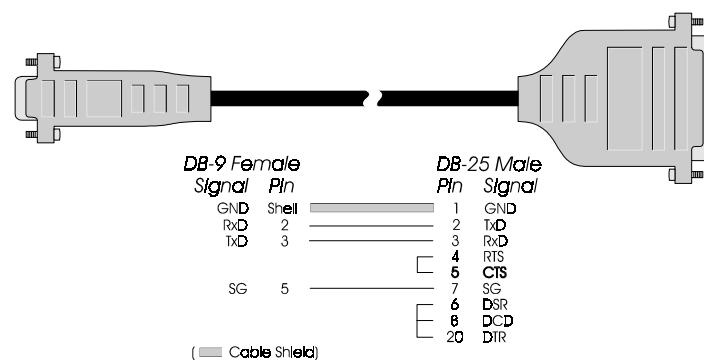
# Appendix C — Terminal Port Cable

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Some terminals will not transmit data if their CTS (Clear To Send) line is LOW. These terminals must have their CTS line HIGH or floating to ensure that they will have no problems communicating with the T1 Modem Bank. The cable shown in Figure 31 can be used if a terminal of this kind does not require hardware handshaking.

**Figure 31**

**Simple Terminal Cable**



## Appendix D — Specifications and Wiring Pin Diagrams

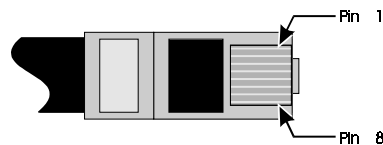
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### Line Card Connector

Figure 32 illustrates an RJ-45 plug that can be inserted into the T1 line card connector.

**Figure 32**

**RJ-45 Plug**



The following are pin assignments for the T1 line interface and the DSX-1 line interface.

Signal	Pin
RxTIP	1
RxRING	2
NC	3
TxTIP	4
TxRING	5
NC	6
NC	7
NC	8

#### Specifications:

Cable: Standard: UL or ETL verified to Category 5 specifications.

Type: Unshielded twisted pair

Number of pairs: 2

Jacket: PVC

Conductor: 24 AWG solid copper

Diameter: .175" + .005, -.03

Color: Gray

Mfg./Model: Berk TEK/530121 (or equivalent)

#### Plug:

Type: Pre-loaded RJ45 male

Material: Polycarbonate

Color: Clear

Contacts: Phosphor-bronze, gold-plated .000020" minimum on contact area

Mfg./Model: AMP/557315-1 (or equivalent)

## Connector for Sync Channels

The following is a pin out of the serial channel of SCA and sync link input

Signal	Pin	Signal	Pin
TxD+	1	TxD-	2
RTS+	3	RTS-	8
TxC-	4	TxC+	5
RxD-	6	RxD+	7
RxC-	9	RxC+	10
CTS-	14	CTS+	15
GND	12	reserved	11

## Terminal Port

The following pin connections are used for the terminal port. This port is located on the HOST IN/OUT and Terminal faceplate.

Signal	Pin
TxD	3
RxD	2
CTS	8
RTS	7
SG	5

### **Note:**

CTS is not needed from the remote terminal for proper data transfers.

# Appendix E — Generic T1 Modem Bank Wiring Modes

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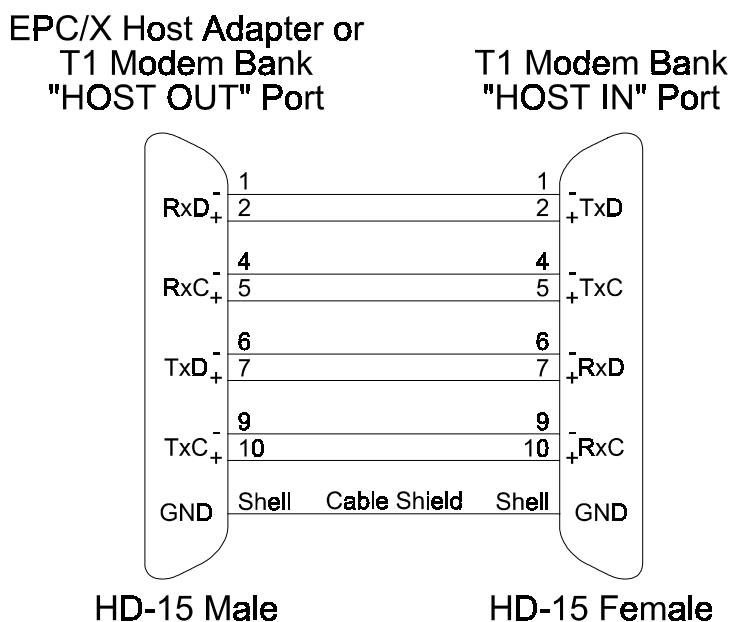
There are three basic wiring modes for connecting T1 Modem Bank units to an EPC/X host adapter or to each other: Eight-Wire Direct, Four-Wire Direct (also called Four-Wire Self-Clocking), and Eight-Wire Synchronous Modem (or Eight-Wire Externally Clocked).

## Eight-Wire Direct Wiring

Eight-Wire Direct is the standard method for connecting T1 Modem Bank units to EPC/X host adapter synchronous lines and to other T1 Modem Bank units. It provides transmit and receive data signals plus discrete clock signals for transmit and receive data. This permits synchronous data rates of up to 10M bps, which results in the maximum data throughput under moderate to heavy loads. (See Table 8 on page 96 for restrictions on cable lengths). The synchronous cables provided with the T1 Modem Bank units are Eight-Wire Direct cables. The Eight-Wire Direct cable is a twisted pair cable with a male HD-15 (high-density DB-15) connector at one end and a female HD-15 at the other end. The cable should be shielded, and the shield must be connected to the HD-15 connector shell at both ends. See Figure 33.

**Figure 33**

**Eight-Wire Direct Daisy Chain Cable Wiring**



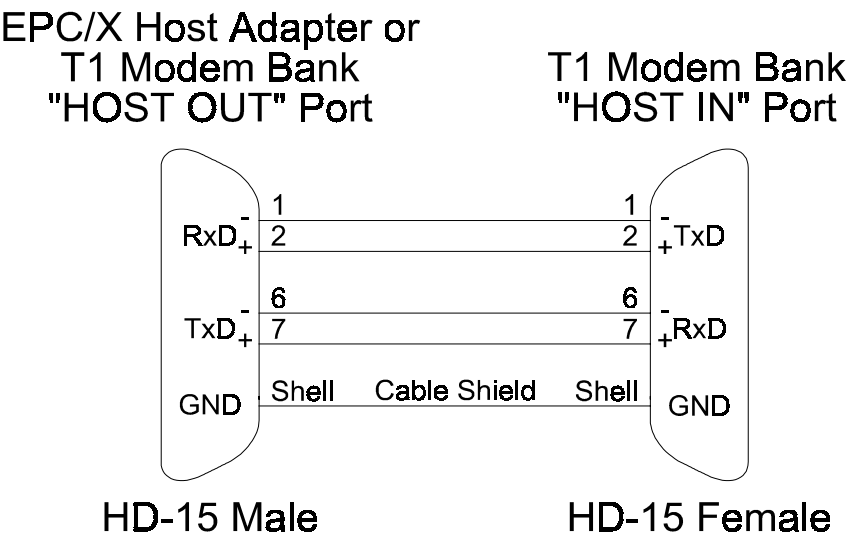


# Four-Wire Direct Wiring

Four-Wire Direct wiring connects T1 Modem Bank units where longer synchronous cable runs are necessary. While not as fast as Eight-Wire connections (the maximum data transfer rate is 1.8 megabaud<sup>1</sup>), this wiring method is more economical, and is sufficient in all but the most demanding high-performance applications. This means that terminal users should see no degradation in performance. In the Four-Wire Direct wiring mode, the clock signals are encoded with the receive and transmit data signals, so only two twisted pairs are required. The Four-Wire Direct cable is a twisted pair cable with a male HD-15 (high-density DB-15) connector at one end and a female HD-15 at the other end. The cable should be shielded, and the shield must be connected to the HD-15 connector shell at both ends. See Figure 34.

Figure 34

Four-Wire Direct Daisy Chain Cable Wiring



<sup>1</sup> If each T1 line transmits at 1.544 Mbit/second, only one T1 Modem Bank can be connected to this line and still maintain the full data rate. See Table 8 on page 96 for restrictions on cable lengths.

## Restrictions on Daisy Chain Cable Lengths

The maximum length of a daisy chain is dependent upon the synchronous data rate. Table 8 lists the maximum *cumulative* daisy chain cable lengths for various baud rates. For example, to run a synchronous line at 10 megabaud, the total length of all daisy chain cables for that synchronous line may not exceed 30 feet. Thus, a single T1 Modem Bank could be placed 30 feet from the EPC/X host adapter, or six T1 Modem Bank units could be spaced at 5 foot intervals and still operate at 10 megabaud.

**Table 8** **Daisy Chain Cable Length vs. Baud Rate**

Baud Rate	Maximum Cable Length (24AWG Twisted Pair, 12 pF/foot)
0 - 460K	2000 feet
0 - 1.2M	1000 feet
0 - 2.5M	300 feet
0 - 5M	120 feet
0 - 10M	30 feet

# Eight-Wire Synchronous Modem Wiring

Eight-Wire Synchronous Modem wiring allows T1 Modem Bank units to be installed in remote locations and connected to the EPC/X host adapter via RS-232 or RS-422 synchronous modems.

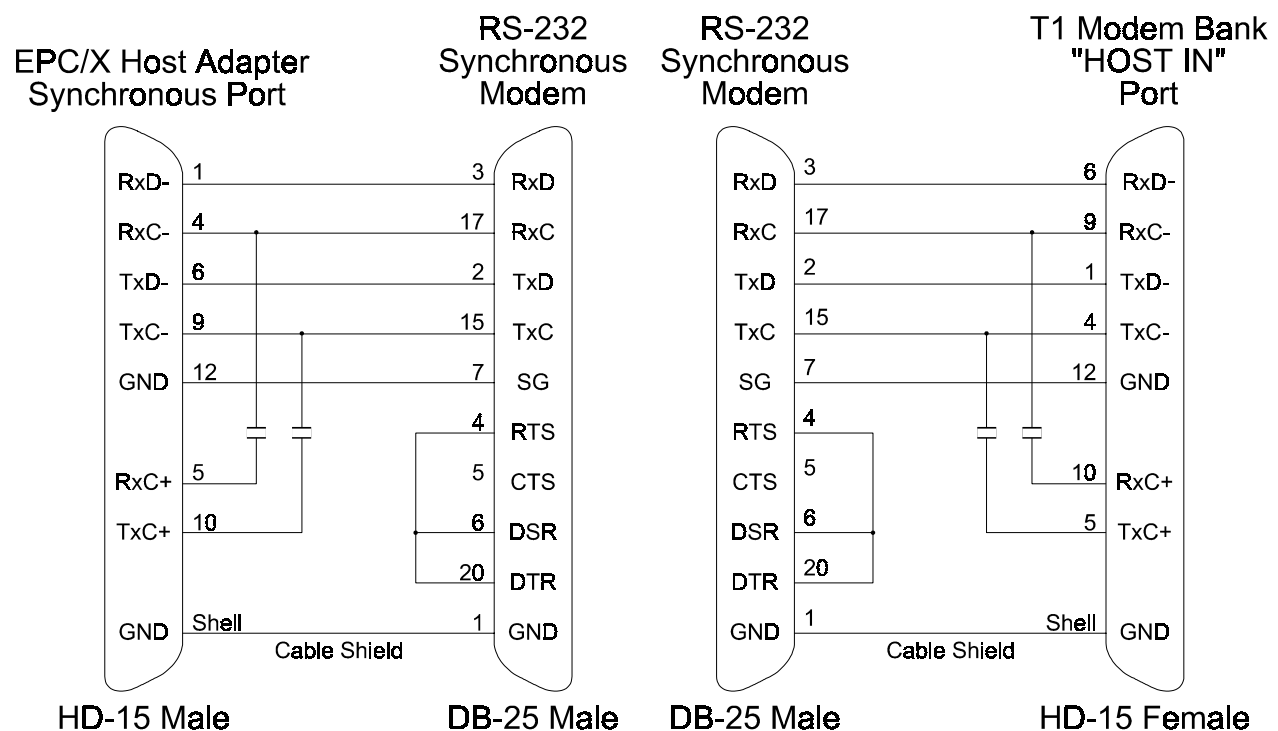
The EPC/X host adapter and the T1 Modem Bank have been designed so that the synchronous ports can support either RS-422 or RS-232 line levels. To connect EPC/X host adapters and T1 Modem Banks to RS-232 synchronous modems, use the special cables shown in Figure 35.

Note that only the negative lead for each RS-422 signal is used in this configuration. The positive lead is left “floating”.

If you are building your own cable, four 2200 pF capacitors (X7R 50V type) are required—two for the EPC/X host adapter and two for the T1 Modem Bank. Install the capacitors between the positive and negative leads of the TxC and RxC signals on the back of the HD-15 connectors, as shown in Figure 35.

**Figure 35**

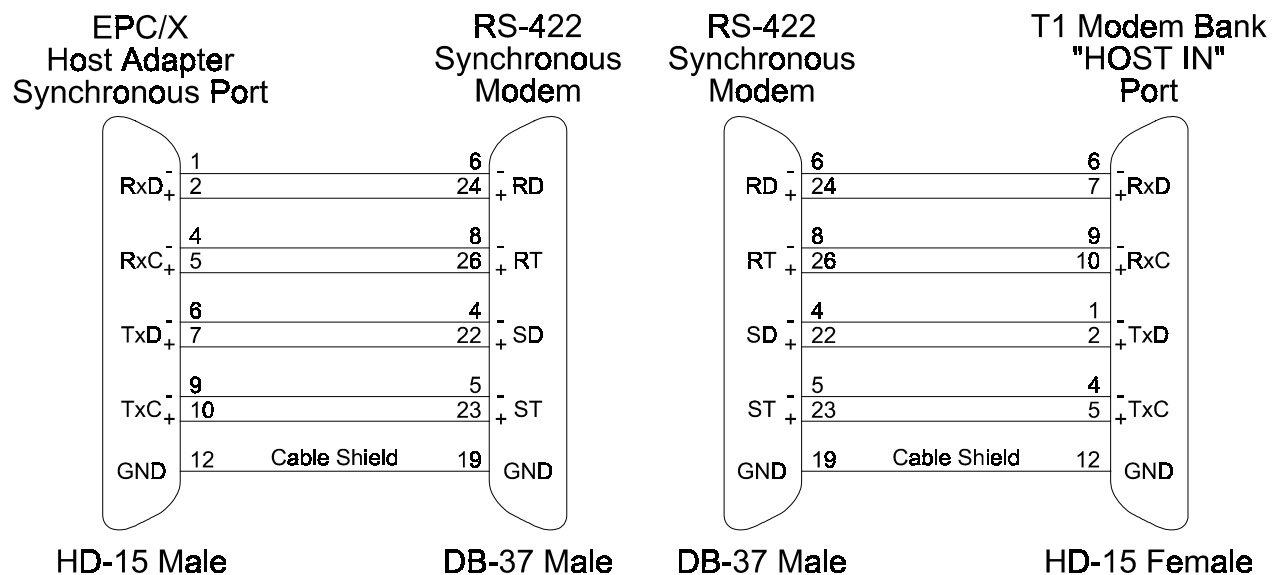
**RS-232 Synchronous Modem Cables**



RS-422 synchronous modems can also be used with the EPC system. The required cables are shown in Figure 36.

**Figure 36**

**RS-422 Synchronous Modem Cables**



The RS-422 Synchronous Modem cables are twisted pair cables, each having an HD-15 (high-density DB-15) connector at one end and a DB-37 connector at the other end. The cable should be shielded, and the shield must be connected as shown in the above diagram.

# Appendix F — Modem AT Command Set

---

**Note:**

Default values of command parameters, if applicable, are indicated by an asterisk (\*).

## Basic AT Commands

### **A/** Repeat Last Command

Repeats execution of the previous command string. “A/” must not be preceded with AT, or followed by pressing <Enter>.

### **A** Answer

Causes the modem to go off-hook and attempt to establish a connection, even in the absence of a ring.

### **Bn** Line Modulation Options

Configures the modem to the desired communications standard setting at a particular line speed.

**B0:** Selects CCITT V.22 mode when the modem is at 1200 bps, and CCITT V.21 when the modem is at 300 bps.

\* **B1:** Selects Bell 212A when the modem is at 1200 bps, and Bell 103 when the modem is at 300 bps.

**B2:** Selects V.23 originate mode receive 1200 bps, transmit 75 bps; answer mode receive 75 bps, transmit 1200 bps.

**B3:** Selects V.23 originate mode receive 75 bps, transmit 1200 bps; answer mode receive 1200 bps, transmit 75 bps.

Result Codes:

**OK**           Returned when *n* = 0, 1, 2 or 3.

**ERROR**       Returned for any other value of *n*.

### **Cn** Carrier Control Option (no operation)

This command is included to provide backward compatibility with communications software that issues this command.

**C0:** Returns ERROR.

**C1:** Normal transmit carrier switching.

Result Codes:

**OK**           Returned when *n* = 1.

**ERROR**       Returned for any other value of *n*.

## **Dn Dial Command**

Initiates the dialing sequence. The string *n* includes the dial modifiers and the telephone number to be dialed.

Dial Modifiers:

- P:** Pulse dial. Only digits 0-9 may be used in pulse dial mode.
- R:** Reverse dial mode. Originates call in answer mode.
- S=*n*:** Dial stored number. Dials the number stored in location *n* (0-3).
- T** Tone DTMF dial. Any digit 0-9, \*, #, A, B, C, D may be dialed as a tone.
- W** Wait for dial tone. The modem waits for dialtone before dialing.
- ,** Pause. Causes the modem to pause before processing the next character in the dial string.
- !** Flash hook. Causes the modem to go on-hook for 0.5 seconds, then go off-hook again.
- @** Wait for quiet answer. Wait for five seconds of silence after dialing the number.
- ;** Return to idle state. Modem returns to command mode after dialing a number, but does not disconnect call.

## **En AT Command Echo Options**

Enables or disables echo of characters from the modem to the DTE when the modem is in command mode.

**E0:** Echo disabled.

\* **E1:** Echo enabled.

Result Codes:

**OK** Returned when *n* = 0 or 1.

**ERROR** Returned for any other value of *n*.

## **Fn Online Echo Command (no operation)**

This command is included to provide backward compatibility with communications software that issues this command.

**F0:** Returns ERROR.

**F1:** Online echo disabled.

Result Codes:

**OK** Returned when *n* = 1.

**ERROR** Returned for any other value of *n*.

## **Hn Switchhook Control**

Provides control of the line relay.

**H0:** Causes modem to go on-hook.

**H1:** Causes modem to go off-hook, but does not train.

Result Codes:

**OK** Returned when *n* = 0 or 1.

**ERROR** Returned for any other value of *n*.

## **In      Modem Identification**

Causes modem to provide information about itself.

- I0:** Returns product code (for example, “Digi International Modem/Xem”).
- I1:** Returns 3-digit checksum of ROM.
- I2:** Checks ROM by calculating and verifying checksum. Returns “ROM IS OK” or “ERROR”.
- I3:** Returns type of ROM (for example, “ROM 27C010”).
- I4:** Returns modem capabilities: “007040C0040000”

Result Codes:

- OK**              Returned when **n** = 0, 1, 2, 3 or 4.
- ERROR**        Returned for any other value of **n**.

## **Ln      Speaker Volume (dummy command)**

This command is used by some modems to control speaker volume. This product supports this command only to ensure compatibility with scripting tools. This command has no effect.

- L0:** Lowest speaker volume.
- L1:** Low speaker volume.
- \* **L2:** Medium speaker volume.
- L3:** High speaker volume.

Result Codes:

- OK**              Returned when **n** = 0, 1, 2 or 3
- ERROR**        Returned for any other value of **n**.

## **Mn      Speaker Control (dummy command)**

This command is used by some modems to enable the speaker. This product supports this command only to ensure compatibility with scripting tools. This command has no effect.

- M0:** Speaker always off.
- \* **M1:** Speaker on until carrier present.
- M2:** Speaker always on.
- M3:** Speaker off during dialing and on until carrier.

Result Codes:

- OK**              Returned when **n** = 0, 1, 2 or 3
- ERROR**        Returned for any other value of **n**.

## **Nn**     **Select Negotiate Handshake**

Controls automode enable/disable.

**N0**: When originating or answering, handshake only at the communication rate specified by register **S37** and command **Bn**, with no fallback.

- \* **N1**: When originating or answering, start handshake at the communication standard specified by register **S37** and command **Bn**. During handshake, fallback to lower speed may occur except in **W1** mode.

Result Codes:

**OK**             Returned when **n** = 0 or 1.

**ERROR**        Returned for any other value of **n**.

## **On**     **Go Online**

Causes the modem to go to online or data mode.

**O0**: Returns modem to previously established rate.

**O1**: Begins an equalizer retrain sequence, then returns to online state.

**O3-14**:

Forces the modem to a new rate (defined in register **S62**).

Result Codes:

**OK**             Returned when **n** = 0, 1 or 3-14.

**ERROR**        Returned for any other value of **n**.

## **P**        **Enable Pulse dialing**

Instructs the modem to use pulse dialing. Dialed digits will be pulse dialed until a **T** command or dial modifier is received. Tone dial is the default setting.

## **Qn**     **Result Code Display Option**

Controls whether result codes are returned to the DTE.

- \* **Q0**: Enable result codes.

**Q1**: Disable result codes.

Result Codes:

**OK**             Returned when **n** = 0 or 1.

**ERROR**        Returned for any other value of **n**.

## **Sn**     **Select S Register n**

Selects a specific S register.

**n**=0-99

## **Sn=m**   **Write to S Register n**

Writes the value **m** to S register **n**.

**n**=0-99

**m**=0-255



**Sn? Read S Register *n***

Reports the value of S register *n* as a 3-digit decimal number.

*n*=0-99

**T Enable Tone dialing**

Instructs the modem to use DTMF tones when dialing. Dialed digits will be tone dialed until a **P** command or dial modifier is received. Tone dial is the default setting.

**Vn Result Code Format**

Controls whether result codes are returned to the DTE.

**V0:** Numeric form (0 for OK).

\* **V1:** Verbose form (OK for OK).

Result Codes:

**OK** Returned when *n* = 0 or 1.

**ERROR** Returned for any other value of *n*.

**Wn Select Extended Result Codes**

Defines which result codes are to be used to identify the type of connection and protocol that resulted from handshaking and negotiation.

\* **W0:CONNECT** result code reports DTE speed.

**W1:CONNECT** result code reports DTE speed, plus the **CARRIER**, **COMPRESSION** and **PROTOCOL** extended result codes.

**W2:CONNECT** result code reports DCE speed.

Result Codes:

**OK** Returned when *n* = 0, 1 or 2.

**ERROR** Returned for any other value of *n*.

**Xn Select Result Codes/Call Progress Options**

Enables the tone detection options used in the dialing process. As these functions are chosen, the modem chip set's result codes are also affected. This command is therefore frequently used to control the modem chip set's responses. The primary function of this control is to control the modem chip set's call response capabilities.

**X0:** Display **CONNECT** or **1** for all speeds.

**X1:** Display connect message according to **ATW** and **ATV**, blind dial, ignore busy signal.

**X2:** Display connect message according to **ATW** and **ATV**, wait for dial tone, ignore busy signal.

**X3:** Display connect message according to **ATW** and **ATV**, blind dial, check for busy signal after dialing.

\* **X4:** Display connect message according to **ATW** and **ATV**, wait for dial tone, check for busy signal after dialing.

Result Codes:

**OK** Returned when *n* = 0, 1, 2, 3 or 4.

**ERROR** Returned for any other value of *n*.

**Yn     Dummy Command**

Dummy command for compatibility.

**Y0:** Returns OK.

**Y1:** Returns OK.

**Zn     Recall Stored Profile**

Forces the modem to go on-hook and restore the selected profile. Non-storable parameters are returned to their factory settings.

**Z0:** Reset and recall user profile 0.

**Z1:** Reset and recall user profile 1.

Result Codes:

**OK**            Returned when **n** = 0 or 1.

**ERROR**        Returned for any other value of **n**.

## *AT& (Ampersand) Commands*

### **&Bn Autoretrain**

Defines modem action when it receives a poor signal.

**&B0:** Hang up on a poor received signal.

\* **&B1:** Retrain on a poor received signal. Hang up if condition persists longer than the threshold set in register **S7**.

**&B2:** Do not hang up; do not retrain (tolerate any connection).

Result Codes:

**OK** Returned when **n** = 0, 1 or 2.

**ERROR** Returned for any other value of **n**.

### **&Cn Data Carrier Detect Option (Async Only)**

Controls how the state of the DCD or RLSD (Receive Line Signal Detect) relates to the carrier from the remote system. Always use **&C1** for Sync mode.

**&C0:** State of carrier from remote modem is ignored. RLSD circuit is always on.

\* **&C1:** State of carrier from remote modem is tracked. RLSD circuit reflects the state of the carrier.

Result Codes:

**OK** Returned when **n** = 0 or 1.

**ERROR** Returned for any other value of **n**.

### **&Dn Data Terminal Ready Option**

Defines modem action when it receives a poor signal.

**&D0:** DTR ignored.

**&D1:** Go to command mode when DTR changes from on to off.

\* **&D2:** Hang up and go to command mode when DTR changes from on to off. Auto answer is disabled if DTR is low.

**&D3:** Reset when DTR changes from on to off.

Result Codes:

**OK** Returned when **n** = 0, 1, 2 or 3.

**ERROR** Returned for any other value of **n**.

### **&F Load Factory Settings**

Loads the configuration programmed at the factory. This command replaces all command options and S register settings in the active configuration with the factory values stored in the nonvolatile RAM.

**&F:** Recall factory setting as active configuration.

### **&Gn Guard Tone Operation**

Determines which guard tone, if any, to transmit while transmitting in the high band (answer mode). Used only in V.22 and V.22*bis* mode.

- \* **&G0:** No guard tones.
- &G1:** 550 Hz guard tone.
- &G2:** 1800 Hz guard tone.

Result Codes:

- OK** Returned when *n* = 0, 1 or 2.
- ERROR** Returned for any other value of *n*.

### **&Jn Dummy Command for AutoSync**

Dummy command for AutoSync compatibility.

- &J0:** Returns **OK**.
- &J1:** Returns **OK**.

### **&Kn Set Flow Control**

Determines which guard tone, if any, to transmit while transmitting in the high band (answer mode). Used only in V.22 and V.22*bis* mode.

- &K0:** Disable flow control.
- &K1:** Reserved.
- &K2:** Reserved.
- \* **&K3:** Enable bi-directional hardware flow control (RTS/CTS).
- &K4:** Enable bi-directional XON/XOFF flow control.
- &K5:** Error.

Result Codes:

- OK** Returned when *n* = 0, 3 or 4.
- ERROR** Returned for any other value of *n*.

### **&Ln Dial-Up/Leased-Line Option**

Selects between dial-up and leased-line operations. **NOTE: Full-featured leased line operation is not available at this time. Please call Digi Sales for more information.**

- \* **&L0:** Dial line.
- &L1:** Leased line.

Result Codes:

- OK** Returned when *n* = 0 or 1.
- ERROR** Returned for any other value of *n*.

### **&Mn** Select Sync, Async or AutoSync Mode Options

Selects the communication mode.

- \* **&M0:** Async mode.
- &M1:** Sync mode 1. Async off-line and Sync on-line. To switch to on-line command mode, select **&D1** and drop DTR.
- &M2:** Sync mode 2. Autodial stored #0 when DTR changes from off to on, ignore **&D** option, always **&D2** when DTR changes from off to on.
- &M3:** Sync mode 3. Manual dial mode with talk/data switch, same as **&M2** when in on-line mode.
- &M4:** Hayes *AutoSync* mode.

Result Codes:

- OK** Returned when **n** = 0, 1, 2, 3 or 4.
- ERROR** Returned for any other value of **n**.

### **&Pn** Dial Pulse Ratio

Determines the make/break ratio used during pulse dialing.

- \* **&P0:** Make = 39%; Break = 61%; for use in the United States.
- &P1:** Make = 33%; Break = 67%; for use in some other countries.

Result Codes:

- OK** Returned when **n** = 0 or 1.
- ERROR** Returned for any other value of **n**.

### **&Qn** Communications Mode Option

Selects the communication mode. This is the Hayes command, and performs identically to **&Mn**, above.

Result Codes:

- OK** Returned when **n** = 0, 1, 2, 3 or 4.
- ERROR** Returned for any other value of **n**.

### **&Rn** CTS/RTS Option (non-CTS Flow Control Mode)

Defines the functions of CTS.

- \* **&R0:** CTS follows RTS (Synchronous modes only).
- &R1:** CTS always true.

Result Codes:

- OK** Returned when **n** = 0 or 1.
- ERROR** Returned for any other value of **n**.

## **&Sn Data Set Ready Option**

Controls the functions of DSR. DSR indicates when the modem is connected to a communications channel and is ready. Async mode only. If the modem is in Sync mode, DSR is on during handshake and when on-line. DSR is off in test or idle mode.

- \* **&S0:** DSR always on.
- &S1:** DSR on during handshake and when on-line; off in test or idle modes.

Result Codes:

- OK** Returned when *n* = 0 or 1.
- ERROR** Returned for any other value of *n*.

## **&Tn Self Test Commands**

Used to configure and place the modem in various test modes as defined by CCITT V.54. These tests are typically used to verify the analog and digital portions of a modem's operation.

- &T0:** Terminate test.
- &T1:** Local analog loopback.
  - O: low frequency band.
  - A: high frequency band.
- &T3:** Local activate remote digital loopback (RDL).
- \* **&T4:** Grant request from remote for RDL test.
- &T5:** Deny request from remote for RDL test.
- &T6:** Remote digital loopback test.
- &T7:** Remote digital loopback with self test.
- &T8:** Local analog loopback with self test.

Result Codes:

- OK** Returned when *n* = 0, 3, 4, 5, 7 or 8.
- CONNECT** Returned when *n* = 1 or 6.
- ERROR** Returned for any other value of *n*.

## **&Vn View Active Configuration and Stored Profile**

Displays the active and stored profiles (commands and S register settings), and any stored telephone numbers. The following example illustrates typical &V information for the Digi Modem/Xem.

**&V0:** View active file, stored profile #0, and stored phone numbers.

**&V1:** View active file, stored profile #1, and stored phone numbers.

EXAMPLE:

### **ACTIVE PROFILE:**

```
B1 E1 L2 M1 N1 P Q0 V1 W0 X4 Y0 &B1 &C1 &D2 &G0 &J0 &K3 &L0 &P0 &Q0
&R0 &S0 &U0 &X0 &Y0
%A013 %C1 %E1 %G0 %01 \A3 \C0 \G0 \J0 \K5 \N3 \Q3 \T000 \V1 \X0 -J1
"H3 "0016
S00:000 S01:000 S02:043 S03:013 S04:010 S05:008 S06:002 S07:030
S08:002 S09:006 S10:014 S11:095 S12:050 S18:000 S25:005 S26:001
S37:000
```

### **STORED PROFILE 0:**

```
B1 E1 L2 M1 N1 P Q0 V1 W0 X4 Y0 &B1 &C1 &D2 &G0 &J0 &K0 &L0 &P0 &Q0
&R0 &S0 &U0 &X0 &Y0
%A013 %C1 %E1 %G0 %01 \A3 \C0 \G0 \J0 \K5 \N3 \Q3 \T000 \V0 \X0 -J1
"H3 "0016
S00:000 S02:043 S06:002 S07:030 S08:002 S09:006 S10:014 S11:095
S12:050 S18:000 S25:005 S26:001 S37:000
```

### **TELEPHONE NUMBERS:**

```
&Z0=          &Z1=
&Z2=          &Z3=
```

Result Codes:

**OK**           Returned when *n* = 0 or 1.

**ERROR**       Returned for any other value of *n*.

## **&Wn Store Active Profile**

Stores certain command options and S register values into one of the two nonvolatile stored profile locations:

**&W0:** Save active configuration as user profile 0.

**&W1:** Save active configuration as user profile 1.

Result Codes:

**OK**           Returned when *n* = 0 or 1.

**ERROR**       Returned for any other value of *n*.

### **&Xn Sync Transmit Clock Source**

Determines how the DTE transmit clock is generated while the modem is in synchronous modes.

- \* **&X0:** The modem generates the transmit clock and applies it to pin 15 (EIA-232).
- &X1:** The DTE generates the transmit clock on pin 25 (EIA-232) and the modem applies it to pin 15 (EIA-232)
- &X2:** The modem derives the transmit clock from the receive carrier signal and applies it to pin 15 (EIA-232).

Result Codes:

- OK** Returned when **n** = 0, 1 or 2.
- ERROR** Returned for any other value of **n**.

### **&Yn Select Stored Profile on Powerup**

Selects which user profile will be recalled into the active profile when the modem is powered up.

- &Y0:** Select user profile 0.
- &Y1:** Select user profile 1.

Result Codes:

- OK** Returned when **n** = 0 or 1.
- ERROR** Returned for any other value of **n**.

### **&Zn=x Store Telephone Number**

Stores a dialing string **x** in one of four non-volatile memory locations **n**. Dialing strings can be up to 36 characters long, including dial modifiers; spaces are not counted.

**n=0-3**

**x=0-9, A, B, C, D, #, \*, T, P, R, W, @, comma, !, ; (dial string)**



## AT% (Percent) Commands

### **%An** Set Autoreliable Fallback Character

Allows the user to specify the character that tells the modem to return (or fall back) from autoreliable (MNP) mode to a normal connection on the answering modem.

Result Codes:

**OK**           Returned when *n* = 0-127 (ascii character set).

**ERROR**       Returned for any other value of *n*.

Default: 0x0D

### **%Cn** Data Compression

Controls the MNP Class 5 compression. The modem can only perform data compression on an error corrected link.

**%C0:** No compression.

\* **%C1:** MNP Class 5 compression.

Result Codes:

**OK**           Returned when *n* = 0 or 1.

**ERROR**       Returned for any other value of *n*.

### **%Gn** Auto Fallforward/Fallback Enable

Selects the auto fallback option.

**%G0:** Disabled.

\* **%G1:** Enabled.

Result Codes:

**OK**           Returned when *n* = 0 or 1.

**ERROR**       Returned for any other value of *n*.

# AT\ (Backslash) Commands

## **\An** Block Size for V.42

Sets the maximum block size during connection. This option forces the modem chip set to transmit smaller blocks of data. The command is typically used for poor quality telephone lines where transmitting smaller blocks reduces retransmission and improves throughput.

**\A0:** Max 64 characters.

**\A1:** Max 128 characters.

**\A2:** Max 192 characters.

\* **\A3:** Max 256 characters.

Result Codes:

**OK** Returned when *n* = 0, 1, 2 or 3.

**ERROR** Returned for any other value of *n*.

## **\Bn** Transmit Break

Sends a break to the remote modem. Equivalent to using the <Break> key on your terminal. This command can be used if your keyboard does not have a <Break> key.

**\B0 - \B9:** BREAK length, in 100 ms increments.

Result Codes:

**OK** If connected in data mode.

**ERROR** If not connected, or connected in FAX mode.

## **\Cn** Set Autoreliable Buffer

Defines whether the modem buffers the data it receives during link negotiation.

\* **\C0:** Do not buffer data.

**\C1:** Buffers data on answering modem for 4 seconds, until 200 characters have been buffered, then switches to normal mode and the buffered characters are passed to the serial port. If a SYN character is detected, reliable mode is attempted.

**\C2:** Does not buffer data on answering modem. Switches to normal mode upon receipt of autoreliable character and passes it to serial port.

Result Codes:

**OK** Returned when *n* = 0, 1 or 2.

**ERROR** Returned for any other value of *n*.

## **\Gn** Set Modem Port Flow Control (Only in Normal Mode)

Selects the modem's DCE or port flow control. If the modem is receiving data from the remote modem faster than it can be processed, enabling port flow control allows the modem to handle the data efficiently.

\* **\G0:** Disable port flow control.

**\G1:** Set port flow control to XON/XOFF flow control.

Result Codes:

**OK** Returned when *n* = 0 or 1.

**ERROR** Returned for any other value of *n*.

## **\Jn** Constant DTE Speed Option

- \* **\J0:** DCE and DTE rates are independent.
- \J1:** DTE rate adjusts to DCE connection rate after online.

Result Codes:

- OK** Returned when **n** = 0 or 1.
- ERROR** Returned for any other value of **n**.

## **\Kn** Set Break Control

Selects the way in which the modem handles a break signal. The Modem Xem can handle a break in one of three ways: expedited destructive, expedited, or queued break.

*In online data mode with V.42 protocol or normal mode, then break signal to DTE through EIA-232,*

**0, 2, 4:** Enter online command mode but do not send break to remote modem.

**1:** Empty the data buffers and send break to the remote modem immediately.

**3:** Immediately send break to the remote modem.

- \* **5:** Send break to the remote modem in sequence with data.

*In online data mode with direct mode, then receive break at serial port,*

**0, 2, 4:** Immediately send break and enter online command state.

**1, 3, \*5:** Immediately send break through.

*In online command mode with V.42 protocol or normal mode, and the DTE issues a transmit break command,*

**0, 1:** Empty the data buffers and send break to the remote modem.

**2, 3:** Immediately send break to the remote modem.

**4, \*5:** Send break to the remote modem in sequence with data.

*In online data mode with normal mode, receive break signal from remote at modem port, send to serial port,*

**0, 1:** Empty the data buffers and send break to the local DTE.

**2, 3:** Immediately send break to the local DTE.

**4, \*5:** Send break to the local DTE in sequence with data.

Result Codes:

- OK** Returned when **n** = 0, 1, 2, 3, 4 or 5.
- ERROR** Returned for any other value of **n**.

## **\Nn Modem Protocol Options**

Selects the type of data connection the modem can establish.

- \N0:** Normal mode. No protocol, but flow control is allowed.
- \N1:** Direct mode. No protocol and no flow control is allowed.
- \N2:** MNP reliable mode.
- \* **\N3:** LAPM, MNP or Normal mode
- \N4:** LAPM or MNP mode.

Result Codes:

- OK** Returned when **n** = 0, 1, 2, 3 or 4.
- ERROR** Returned for any other value of **n**.

## **\Qn DTE Flow Control Options**

Selects the flow control method the modem provides to the DTE to prevent the modem's buffer from overflowing with data. A data buffer holds the data until the modem is ready to transmit it. When the data buffer is full, flow control instructs the DTE to stop sending to the modem while the modem continues to send characters.

- \Q0:** Disables flow control.
- \Q1:** XON/XOFF software flow control.
- \Q2:** CTS flow control to DTE.
- \* **\Q3:** RTS/CTS hardware flow control.

Result Codes:

- OK** Returned when **n** = 0, 1, 2 or 3.
- ERROR** Returned for any other value of **n**.

## **\Tn Set Inactivity Timer**

Permits the modem to disconnect if no data activity has occurred for the selected period of time.

- \* **n=0:** Disable inactivity timer.
- n=1-90:** Length in minutes.

## **\Wn Protocol Result Code**

Enables/disables the protocol result code on connect (effective only with **W0** and **W2** options)

- \* **\W0:** Disable protocol result code (**Connect 9600**).
- \W1:** Enable protocol result code (**Connect 9600/LAPM**).

Result Codes:

- OK** Returned when **n** = 0 or 1.
- ERROR** Returned for any other value of **n**.

## **\Xn     Set XON/XOFF Passthrough Option**

Valid only if XON/XOFF flow control is enabled, such as with **\G1** or **\Q1**; otherwise, XON/XOFF will not be detected by the modem, and thus will always pass through.

- \* **\X0:**     Process XON/XOFF per **\G** and **\Q** options; do not pass XON/XOFF to the remote modem or local DTE.
- \X1:**     Process XON/XOFF per **\G** and **\Q** options; always pass XON/XOFF to the remote modem or local DTE.

Result Codes:

- OK**             Returned when **n** = 0 or 1.
- ERROR**        Returned for any other value of **n**.

## AT- (Dash) Commands

### **-Jn**     Set V.42 Detection Phase

Defines whether the originating modem sends a sequence to the answering modem to determine the type of error correction it has enabled.

**-J0:**     Disables the V.42 detection phase.

\* **-J1:**     Enables the V.42 detection phase.

Result Codes:

**OK**             Returned when *n* = 0 or 1.

**ERROR**        Returned for any other value of *n*.

## AT" (Quote) Commands

### "Hn V.42bis Compression Control

Controls V.42bis data compression over an error correction link.

"H0: Disable V.42bis.

"H1: Enable V.42bis only when transmitting data.

"H2: Enable V.42bis only when receiving data.

\* "H3: Enable V.42bis for both directions.

Result Codes:

**OK** Returned when *n* = 0, 1, 2 or 3.

**ERROR** Returned for any other value of *n*.

### "Nn V.42bis Dictionary Size

512 bytes < btlz\_dict\_size < maximum RAM allows, default is 1.5 Kbytes.

"N0: 512 bytes.

"N1: 1024 bytes.

"N2: 1536 bytes

Result Codes:

**OK** Returned when *n* = 0, 1 or 2.

**ERROR** Returned for any other value of *n*.

### "On Select V.42bis Maximum String Length

Selects the string size for V.42bis compression.

*n* = 6-64.

\* Default = 32

# Class 1 FAX Commands

The Digi Modem/Xem supports FAX commands conforming to EIA standard 578. These commands are given here with short descriptions; complete descriptions are given in the standard, available from the Electronic Industry Association. It also supports ECM mode and V.17terbo at 19.2K bps.

## **+FCLASS?      Service Class Indication**

Causes the modem to display the current setting. The modem can operate either as a Class 0 data modem or a Class 1 FAX modem. Returns **0** for a Class 0 data modem, or **1** for a Class 1 FAX modem.

## **+FCLASS=?    Service Class Capabilities**

Causes the modem to display the classes it supports. Returns “**0**” if set up for data mode; “**0 , 1**” indicates that the modem is capable of data and Class 1 FAX services.

## **+FCLASS=n    Service Class Selection**

Sets the modem for Class 0 (data) or Class 1 (FAX) operation.

**+FCLASS=0**    Sets the modem for Class 0 data operation.

**+FCLASS=1**    Sets the modem for Class 1 FAX operation.

## **+FTS=?        FTS Range Capabilities**

Modem returns “**0-255**”.

## **+FTS=n        Transmission Silence**

Causes the modem to stop transmitting data and pause for **n** x 10 ms. Modem returns OK after timer has expired.

## **+FRS=?        FRS Range Capabilities**

Modem returns “**0-255**”.

## **+FRS=n        Receive Silence**

Causes the modem to stop transmitting data and pause for **n** x 10 ms for silence; then the timer is reloaded.

## **+FTM=?        FAX Normal Mode Transmit Capabilities**

Causes the modem to output the transmit modulations supported by the modem. See Table 9.

## **+FTM=n        Modem Initiate Training**

Causes the modem to initiate training with modulation of type **n**. Table 9 shows the values you can enter for this command and the meaning of those values.



Table 9

Supported FAX Transmit/Receive Modulations

<i>n</i>	Modulation	Speed (Bits/Second)
<b>3</b>	V.21 ch. 2	300
<b>24</b>	V.27terbo	2400
<b>48</b>	V.27terbo	4800
<b>72</b>	V.29	7200
<b>73</b>	V.17LT	7200
<b>74</b>	V.17ST	7200
<b>92</b>	V.17terbo 192 LT	19200
<b>93</b>	V.17terbo 192 ST	19200
<b>96</b>	V.29	9600
<b>97</b>	V.17LT	9600
<b>98</b>	V.17ST	9600
<b>121</b>	V.17LT	12000
<b>122</b>	V.17ST	12000
<b>145</b>	V.17LT	14400
<b>146</b>	V.17ST	14400

**+FRM=? FAX Normal Mode Receive Capabilities**

Causes the modem to output the receive modulations supported by the modem. See Table 9.

**+FRM=*n* Modem Accept Training**

Causes the modem to accept training with *n* type modulation and the protocol is normal mode. Table 9 shows the values you can enter for this command and the meaning of those values.

Returns **CONNECT** or **1** to DTE after carrier is detected.

**+FTH=? FAX SDLC Mode Transmit Capabilities**

Causes the modem to output the FAX SDLC transmit capabilities supported by **+FTM=?**. See Table 9.

**+FTH=*n* Modem Initiate Training (SDLC)**

Causes the modem to initiate training with *n* type modulation and the protocol is SDLC mode. Table 9 shows the values you can enter for this command and the meaning of those values.

Returns **CONNECT** or **1** to DTE after carrier is detected.

**+FRH=? FAX SDLC Mode Receive Capabilities**

Causes the modem to output the FAX SDLC receive capabilities supported by **+FTM=?**. See Table 9.

**+FRH=*n* Modem Accept Training (SDLC)**

Causes the modem to accept training with *n* type modulation and the protocol is SDLC mode. Table 9 shows the values you can enter for this command and the meaning of those values.

Returns **CONNECT** or **1** to DTE after carrier is detected.

## Class 2 FAX Commands

### **+FAA=*n***      **FAX Auto Answer Enable**

Command Syntax: **+FAA=<value>**

- 0: Answer as FAX modem of type specified by **+FCLASS**.
- 1: Automatically determine whether to answer as FAX or data modem.

### **+FAXERR**      **T.30 Session Error Report**

Command syntax: **+FAXERR**

Response syntax: **+FAXERRR=<value>**

- 0-9      Call placement and termination.
  - 0: Normal and proper end of connection.
  - 1: Ring detected without successful handshake.
  - 2: Call aborted, from **+FK** or **<CAN>**
- 10-19    Transmit Phase A & miscellaneous errors.
- 20-39    Transmit Phase B hang-up codes.
  - 20: Unspecified transmit Phase B error.
  - 23: COMREC invalid command received.
  - 25: DCS sent 3 times without response.
  - 27: Failure to train.
- 40-49    Transmit Phase C hang-up codes.
  - 40: Unspecified transmit Phase C error.
- 50-69    Transmit Phase D hang-up codes.
  - 52: No response to MPS repeated 3 times.
  - 53: Invalid response to MPS.
  - 54: No response to EOP repeated 3 times.
  - 55: Invalid response to EOP.
  - 56: No response to EOM repeated 3 times.
  - 57: Invalid response to EOM.
- 70-89    Receive Phase B hang-up codes.
- 90-99    Receive Phase C hang-up codes.
  - 90: Unspecified receive Phase C error.
- 100-119    Receive Phase D hang-up codes.
  - 100: Unspecified receive Phase D error.
- 120-255    Reserved codes.

### **+FBOR            Data Bit Order Selection.**

Command syntax: **+FBOR=<value>**

- 0: Direct bit order for both Phase C data and Phase B/D data.
- 1: Reversed bit order for Phase C data and direct bit order for Phase B/D data.
- 2: Direct bit order for Phase C data and reversed bit order for Phase B/D data.
- 3: Reversed bit order for both Phase C data and for Phase B/D data.

Note:

Direct bit order:        First bit transferred of each byte on the DTE-DCE link is the first bit transferred in the PSTN data carrier.

Reversed bit order:    Last bit transferred of each byte on the DTE-DCE link is the first bit transferred in the PSTN data carrier.

### **+FCQ            Copy Quality Checking**

Command syntax: **+FCQ=<value>**

- 0: Disables copy quality checking. The modem will generate Copy Quality OK (MCF) responses to complete pages and set +FPTS=1.

### **+FCR            Capability to Receive**

Command syntax: **+FCR=<value>**

- 0: Indicates the modem will not receive message data.
- 1: Indicates the modem can receive message data.

### **+FCTCRTY      ECM Retry Count**

Command syntax: **+FCTCRTY=<value>**

- 0: Disable error correcting mode retries. Error correcting mode is not supported.

## **+FDCC      FAX Capability Parameters**

Command syntax: +FDCC=VR,BR,WD,LN,DF,EC,BF,ST

Response syntax: VR,RB,WD,LN,DF,EC,BF,ST

Valid Values:

- VR:    Vertical resolution  
0:    Normal, 98 lpi  
1:    Fine, 196 lpi
- BR:    Bit rate  
0:    2400 bps V.27ter  
1:    4800 bps V.27ter  
2:    7200 bps V.29 or V.17  
3:    9600 bps V.29 or V.17  
4:    12000 bps V.33 or V.17  
5:    14400 bps V.33 or V.17
- WD:    Page width  
0:    1728 pixels in 215 mm
- LN:    Page length  
0:    A4, 297 mm  
2:    Unlimited length
- DF:    Data compression format  
0:    1-D modified Huffman
- EC:    Error Correction  
0:    Disable ECM
- BF:    Binary file transfer  
0:    Disable BFT
- ST:    Scan time/line
- |    | VR=Normal | VR=Fine |
|----|-----------|---------|
| 0: | 0 ms      | 0 ms    |
| 1: | 5 ms      | 5 ms    |
| 2: | 10 ms     | 5 ms    |
| 3: | 10 ms     | 10 ms   |
| 4: | 20 ms     | 10 ms   |
| 5: | 20 ms     | 20 ms   |
| 6: | 40 ms     | 20 ms   |
| 7: | 40 ms     | 40 ms   |

## **+FDCS            Current Session Results.**

Command syntax: +FDCS?

Response syntax: VR,BR,WD,LN,DF,EC,BF,ST

Valid Values:

- VR:    Vertical resolution  
0:    Normal, 98 lpi  
1:    Fine, 196 lpi
- BR:    Bit rate.  
0:    2400 bps V.27ter  
1:    4800 bps V.27ter  
2:    7200 bps V.29 or V.17  
3:    9600 bps V.29 or V.17  
4:    12000 bps V.33 or V.17  
5:    14400 bps V.33 or V.17
- WD:    Page width  
0:    1728 pixels in 215 mm
- LN:    Page length  
0:    A4, 297 mm  
2:    Unlimited length
- DF:    Data compression format  
0:    1-D modified Huffman
- EC:    Error Correction  
0:    Disable ECM
- BF:    Binary file transfer  
0:    Disable BFT
- ST:    Scan time/line
- |    | VR=Normal | VR=Fine |
|----|-----------|---------|
| 0: | 0 ms      | 0 ms    |
| 1: | 5 ms      | 5 ms    |
| 2: | 10 ms     | 5 ms    |
| 3: | 10 ms     | 10 ms   |
| 4: | 20 ms     | 10 ms   |
| 5: | 20 ms     | 20 ms   |
| 6: | 40 ms     | 20 ms   |
| 7: | 40 ms     | 40 ms   |

The modem will return the negotiated T.30 parameters for the current session.

## **+FDFFC      Data Compression Format Conversion**

Command syntax: **+FDFFC=<value>**

- 0: Disable mismatch checking. The DTE must check the **+FDSC:DF** subparameter, and transfer matching data.

## **+FDIS      Current Session Parameters.**

Command syntax: **+FDIS=VR,BR,WD,LN,DF,EC,BF,ST**

Response syntax: **VR,BR,WD,LN,DF,EC,BF,ST**

Valid Values:

**VR:**      Vertical resolution

0: Normal, 98 lpi

1: Fine, 196 lpi

**BR:**      Bit rate

0: 2400 bps V.27ter

1: 4800 bps V.27ter

2: 7200 bps V.29 or V.17

3: 9600 bps V.29 or V.17

4: 12000 bps V.33 or V.17

5: 14400 bps V.33 or V.17

**WD:**      Page width

0: 1728 pixels in 215 mm

**LN:**      Page length

0: A4, 297 mm

2: Unlimited length

**DF:**      Data compression format

0: 1-D modified Huffman

**EC:**      Error Correction

0: Disable ECM

**BF:**      Binary file transfer

0: Disable BFT

**ST:**      Scan time/line

	VR=Normal	VR=Fine
0:	0 ms	0 ms
1:	5 ms	5 ms
2:	10 ms	5 ms
3:	10 ms	10 ms
4:	20 ms	10 ms
5:	20 ms	20 ms
6:	40 ms	20 ms
7:	40 ms	40 ms

**+FDR            Begin or continue Phase C Receive Data.**

Command syntax: +FDR

This command will initiate a transition to Phase C data reception.

**+FDT            Begin Phase C Data Transmission.**

Command syntax: +FDT

This command prefixes Phase C data transmission.

**+FECM          Error Correction Mode Control.**

Command syntax: +FECM=<value>

0: Error correcting mode disabled.

**+FET            Transmit Page Punctuation.**

Command syntax: +FET=<ppm>

- 0: [PPS-]MPS        Another page next, same document.
- 1: [PPS-]EOM       Another document next.
- 2: [PPS-]EOP       No more pages or documents.
- 3: PPS-NULL        Another partial page next.
- 4: [PPS-]PRI-MPS   Another page, procedure interrupt.
- 5: [PPS-]PRI-EOM   Another document, procedure interrupt.
- 6: [PPS-]PRI-EOP   All done, procedure interrupt.
- 7: CTC              Continue to correct.

This command is used to punctuate page and document transmission, after one or more +FDT commands.

**+FK            Session Termination.**

Command syntax: +FK

This command causes the modem to terminate the session in an orderly manner.

**+FLID          Local ID String.**

Command syntax: +FLID="<local ID string>"

Valid values: ASCII string can be up to 20 characters.

Response syntax: +FLID=?

Return value: (20), (32-127)

**+FLNFC        Page Length Format Conversion.**

Command syntax: +FLNFC=<value>

0: Disables mismatch checking. The DTE must check the +FDCS:LN subparameter, and transfer matching data.

**+FLPL         Indicate Document to Poll.**

Command syntax: +FLPL=<value>

0: Indicates that the DTE has no document to poll.

**+FMDL         Request Model Identification.**

Command syntax: +FMDL?

Response value: The information text cannot exceed 2048 characters.

This command causes the modem to send one or more lines of information text which is used to identify the product.

**+FMFR           Manufacturer's Identification.**

Command syntax: +FMFR?

Response value: The information text cannot exceed 2048 characters.

This command causes the modem to send one or more lines of information text which is used to identify the manufacturer.

**+FREV           Request Product Revision Identification.**

Command syntax: +FREV?

Response value: The information text cannot exceed 2048 characters.

This command causes the modem to send one or more lines of information text which is used to identify the version, revision level or data, or other pertinent information.

**+FPHCTO       DTE Phase C Response Time-out.**

Command syntax: +FPHCTO=<value>

value = 0 - 255 (100 ms units)

Default value: 30

This value determines how long the modem will wait for a command after reaching the end of data when transmitting in Phase C.

**+FPTS           Page Transfer Status.**

Command syntax: +FPTS=<ppr>

- 1: MCF   Page good.
- 2: RTN   Page good; retrain requested.
- 3: RTP   Page good; retrain requested.

**+FRBC           Phase C Receive Data Block Size.**

Command syntax: +FRBC=<value>

- 0: Stream mode, Phase C data is terminated by <DLE><ETX>.

**+FREL           Phase C Received EOL Alignment.**

Command syntax: +FREL=<value>

- 0: Indicates that EOL patterns are aligned as received.

**+FSPL           Request to Poll.**

Command syntax: +FSPL=<value>

- 0: Indicates that the DTE does not want to poll.

**+FTBC           Phase C Transmit Data Block Size.**

Command syntax: +FTBC=<value>

- 0: Stream mode, Phase C data is terminated by <DLE><ETX>.



## Class 2 FAX Responses

### **+FCFR            Indicate Confirmation to Receive.**

Syntax: +FCFR

Usage: Indicates the reception of an acceptable TCF training burst and valid DCS signal from the remote machine.

### **+FCON            Facsimile Connection Response.**

Syntax: +FCON

Usage: Indicates connection with a FAX machine. Generated in response to an originate command or answer command.

### **+FCSI            Reports the Remote ID.**

Syntax: +FCSI:"<CSI ID string>"

Usage: Reports the Called Station's ID.

### **+FDCS            Reports DCS Frame Information.**

Syntax: +FDCS:VR,BR,WD,LN,DF,EC,BF,ST

Usage: Reports negotiated parameters for the current session. The subparameters are described in the +FDCS command description.

### **+FDIS            Reports DIS Frame Information.**

Syntax: +FDIS:VR,BR,WD,LN,DF,EC,BF,ST

Usage: Reports remote FAX capabilities and intentions. The subparameters are described in the +FDIS command description.

### **+FET            Post Page Message Response.**

Syntax: +FET:<ppm>

Usage: Generated by the receiving modem after the end of Phase C reception, on receipt of the post-page message from the transmitting station. The <ppm> codes are described in the +FET command description.

### **+FHNG            Call Termination with Status.**

Syntax: +FHNG:<hangup status code>

Usage: Indicates that the call has been terminated. The <hang-up status code> values are described in the +FAXERR command description.

### **+FPTS            Receive/Transmit Page Transfer Status.**

Syntax: +FPTS:<ppr>

Usage: Reports a <ppr> number representing the copy quality and related post-page message. The valid <ppr> values are defined in the +FPTS command description.

### **+FTSI            Report the Remote ID.**

Syntax: +FTSI:"<TSI ID string>"

Usage: Reports the transmitting station's ID.

# S Registers

All bit-mapped registers are read-only. The appropriate AT command which controls the relevant bits in the S register should be used to change the value.

The factory default values are stored in ROM and are loaded into the active configuration at powerup or by the `ATZn` command. In addition, the designated default profile can be changed by entering the `&Yn` command where n is one of the two possible user profiles.

All of the factory default values may be loaded at any time by entering the `&F` command.

## S Register Definitions

### S0 Autoanswer Ring Count

Sets the number of the rings required before the modem automatically answers a call. Setting this register to zero disables autoanswer mode.

Range: 0-255  
Default: 000  
Units: rings

### S1 Ring Count

The value of S1 is incremented with each ring. If no rings occur over an 8 second interval, this register is cleared.

Range: 0-255  
Default: 000  
Units: rings

### S2 Escape Character (user defined)

S2 holds the decimal value of the ASCII character used as the escape character. The default value corresponds to an ASCII +. A value over 127 disables the escape process, i.e., no escape character will be recognized.

Range: 0-255  
Default: 043  
Units: ASCII

### S3 Carriage Return <CR> Character (user defined)

Sets the command line and result code terminator character. Pertains to asynchronous operation only.

Range: 0-127, ASCII decimal  
Default: 013 (carriage return)  
Units: ASCII

### S4 Line Feed <LF> Character (user defined)

Sets the character recognized as a line feed. Pertains to asynchronous operation only. The line feed control character is output after the carriage return control character if verbose result codes are used.

Range: 0-27, ASCII decimal  
Default: 010 (Line Feed)  
Units: ASCII

### S5 Back Space <BS> Character (user defined)

Sets the character recognized as a backspace. Pertains to asynchronous operation only. The modem will not recognize the backspace character if it is set to a value that is greater than 32 ASCII. This character can be used to edit a command line. When the echo command is enabled, the modem echoes back to the local DTE, the backspace character, an ASCII space character, and a second backspace character; this means a total of three characters are transmitted each time the modem processes the backspace character.

Range: 0-127, ASCII decimal  
Default: 008 (backspace)  
Units: ASCII

### **S6 Wait Before Dialing**

Sets the length of time, in seconds, that the modem must wait (pause) after going off-hook before dialing the first digit of the telephone number. The modem always pauses for a minimum of 2 s, even if the value of **S6** is less than 2 s. The wait for dial tone call progress feature (W dial modifier in the dial string) will override the value in register **S6**. This operation, however, may be affected by some ATX options according to country restrictions.

Range: 2-255

Default: 002

Units: seconds

### **S7 Wait for Carrier**

Sets the time, in seconds, that the modem must wait before hanging up because carrier is not detected. The timer is started when the modem finishes dialing (originate), or goes off-hook (answer). In originate mode, the timer is reset upon detection of answer tone if allowed by country restrictions. This timer also specifies the *wait for silence* time for the @ dial modifier in seconds. **S7** is not associated with the W dial modifier.

Range: 1-255

Default: 060

Units: seconds

### **S8 Pause Time for Command or Dial Modifier**

Sets the time, in seconds, that the modem must pause when the “,” dial modifier is encountered in the dial string.

Range: 0-255

Default: 002

Units: seconds

### **S9 Carrier Validation Time**

Sets the time, in tenths of a second, that the carrier must be present before the modem considers it valid and turns on RLSD. As this time is increased, there is less chance to detect a false carrier due to noise from the telephone line.

Range: 1-255

Default: 006 (0.6 second)

Units: 0.1 s

### **S10 Lost Carrier Delay**

Sets the length of time, in tenths of a second, that the modem waits before hanging up after a loss of carrier. This allows for a temporary carrier loss without causing the local modem to disconnect. When register **S10** is set to 255, the modem functions as if a carrier is always present.

The actual interval the modem waits before disconnecting is the value in register **S10** minus the value in register **S9**. Therefore, the **S10** value must be greater than the **S9** value or else the modem disconnects before it recognizes the carrier.

Range: 1-255

Default: 014 (1.4 s)

Units: 0.1 s

### **S11 DTMF Duration and Interdigit Delay**

Range: 50-255

Default: 095 ms

Units: 0.001 s

## **S12 Guard Time**

Defines the maximum period, in 2-hundredths of a second, allowed between consecutive asynchronous escape characters (+) for the escape sequence to be considered valid.

Range: 0-255

Default: 050 (1 s)

Units: 0.02 s

## **S14 Bit-Mapped Options**

Indicates the status of command options.

Default: (AAh), (170d), (10101010b)

Bit 0	Reserved.
Bit 1	Command echo ( <i>En</i> )
0	E0 Echo off
1	E1 Echo on
Bit 2	Response ( <i>Qn</i> )
0	Q0 on
1	Q1 off
Bit 3	Result codes ( <i>Vn</i> )
0	V0 is selected
1	V1 is selected
Bit 4	Dumb Mode
0	dumb mode off (normal)
1	dumb mode on
Bit 5	Tone/Pulse Dialing
0	T tone
1	P pulse
Bit 6	Reserved
Bit 7	Originate/Answer
0	answer
1	originate

## **S16 Bit-Mapped Option Status**

Indicates the test in progress status.

Default: 000

Bit 0	Local analog loopback
0	local ALB disabled
1	local ALB enabled (&T1)
Bit 1	Reserved
Bit 2	Local digital loopback
0	local DL disabled
1	local DL enabled (&T3)
Bit 3	Remote digital loopback (RDL) status
0	RDL off
1	RDL in progress
Bit 4	RDL requested
0	RDL not active
1	RDL active (&T6)
Bit 5	RDL w/ self-test
0	RDL w/ self-test disabled
1	RDL w/ self-test enabled (&T7)
Bit 6	Local analog loopback (ALB) w/ self-test
0	ALB w/ self-test disabled
1	ALB w/ self-test enabled (&T8)
Bit 7	Reserved

### **S18 Modem Test Timer**

Sets the length of time, in seconds, that the modem conducts a test (commanded by **&Tn**) before returning to the command mode. If this register value is zero, the test will not automatically terminate; the test must be terminated from the command mode by issuing an **&T0** or **H** command.

Range: 0-255 seconds

Default: 000

### **S19 AutoSync Protocol Support Mode**

Default = (1Ah) (26d) (00011010b)

Bit 0    Reserved

Bit 1    0    Bisync protocol  
          1    **HDLC protocol**

Bit 2    **0    Address detector disabled**  
          1    Address detector enabled

Bit 3    0    NRZI bit coding  
          1    **NRZ bit coding**

Bit 4    0    Selects mark idle  
          1    **Selects flag idle**

Bit 5-7   Reserved

### **S20 AutoSync HDLC Address**

Default = 255

In HDLC mode:   HDLC address.

In Bisync mode:   definition of Bisync sync character.

## S21 Bit-Mapped Options

Indicates the status of command options.

Default: (30h), (048d), (00110000b)

- |          |  |
|----------|--|
| Bit 0    | Reserved.                              |
| Bit 1    | Reserved                               |
| Bit 2    | CTS behavior (&R <i>n</i> )            |
| 0        | <b>&amp;R0 CTS follows RTS</b>         |
| 1        | &R1 CTS is always on                   |
| Bit 4, 3 | DTR behavior (&D <i>n</i> )            |
| 00       | &D0 ignore                             |
| 01       | &D1 return to command mode             |
| 10       | <b>&amp;D2 disconnect</b>              |
| 11       | &D3 reset modem                        |
| Bit 5    | DCD behavior (&C <i>n</i> )            |
| 0        | &C0 DCD is always on                   |
| 1        | <b>&amp;C1 DCD is on after connect</b> |
| Bit 6    | DSR behavior (&S <i>n</i> )            |
| 0        | <b>&amp;S0 DSR is always on</b>        |
| 1        | &S1 DSR is on after connect            |
| Bit 7    | Reserved                               |



## S22 Bit-Mapped Options

Indicates the status of command options.

Default: (76h), (118d), (01110110b)

Bit 1, 0 Speaker volume (*L<sub>n</sub>*)

- 00 L0 is selected
- 01 L1 is selected
- 10 L2 is selected**
- 11 L3 is selected

Bit 3, 2 Speaker control (*M<sub>n</sub>*)

- 00 M0 is selected
- 01 M1 is selected**
- 10 M2 is selected
- 11 M3 is selected

Bit 6, 5, 4 Result codes and call progress (*X<sub>n</sub>*)

- 000 X0 is selected
- 001 Reserved
- 010 Reserved
- 011 Reserved
- 100 X1 is selected
- 101 X2 is selected
- 110 X3 is selected
- 111 X4 is selected**

Bit 7 Make break ratio (*&P<sub>n</sub>*)

- 0 &P0 is selected**
- 1 &P1 is selected

### S23 Bit-Mapped Options

Indicates the status of command options.

Default: (001), (015d), (00001111b)

Bit 0 Grant RDL

0 &T5 is selected

1 **&T4 is selected**

Bit 3, 2, 1 Reserved

Bit 5, 4 Word length (7 bits)

00 **even parity**

01 space parity

10 odd parity

11 mark parity

Bit 7, 6 Guard tones (&Gn)

00 **disabled**

01 550 Hz

10 1800 Hz

11 not used

### S25 DTR Debounce time

Sets the length of time that the modem will ignore DTR for before hanging up. Its units are seconds for synchronous mode 1 and one hundredths of a second for other modes.

Range: 0-255 (1 second for synchronous mode 1; 0.01 s otherwise)

Default: 005

Units: 0.05 s

### S26 RTS to CTS Delay Interval

Sets the time delay, in hundredths of a second, before the modem turns CTS ON after detecting an OFF-to-ON transaction on RTS when &R0 is commanded. Pertains to synchronous operation only.

Range: 0-255

Default: 001

Units: 0.01 s

## **S27 Bit-Mapped Option**

Indicates the status of command options.

Default: (40h), (064d), (01000000b)

Bit 3, 1, 0 Synchronous/asynchronous selection (&Q*n*, &M*n*)

**000 &Q0, &M0 is selected**

001 &Q1, &M1 is selected

010 &Q2, &M2 is selected

011 &Q3, &M3 is selected

100 &Q4, &M4 is selected

Bit 2 Leased line control (&L*n*)

**0 &L0 is selected**

1 &L1 is selected

Bit 5, 4 Sync transmit clock select (&X*n*)

**00 &X0 internal clock**

01 &X1 external clock

10 &X2 TX slave to RX clock

11 Reserved

Bit 6 ITU-T/Bell mode select (B*n*)

0 B0 is selected

**1 B1 is selected**

Bit 7 Reserved

## **S30 Inactivity Timer Value**

Range: 0-90

Default: 000

Units: Minutes

### **S37 Desired DCE Speed**

Default = 000

**0 = Attempt to connect at the last AT speed**

3 = Attempt a 300 bits/s connection

5 = Attempt a 1200 bits/s connection

6 = Attempt a 2400 bits/s connection

7 = Attempt a 4800 bits/s connection

8 = Attempt a 7200 bits/s connection

9 = Attempt a 9600 bits/s connection

10 = Attempt a 12000 bits/s connection

11 = Attempt a 14400 bits/s connection

12 = Attempt a 16800 bits/s connection

13 = Attempt a 19200 bits/s connection

14 = Attempt a 21600 bits/s connection

15 = Attempt a 24000 bits/s connection

16 = Attempt a 26400 bits/s connection

17 = Attempt a 28800 bits/s connection

18 = Attempt a 31200 bits/s connection

19 = Attempt a 33600 bits/s connection

### **S40 Bit-Mapped Option Status**

Default = 077

Bit 0 Automode select (*Nn*)

0 NO disabled

**1 N1 enabled**

Bit 1-5 Reserved

Bit 6 V.42 detection phase (*-Jn*)

0 -J0 disabled

**1 -J1 enabled**

Bit 7 Reserved

### **S41 Connect Message Display**

Default = 000

**0 = CONNECT with DTE speed**

1 = CONNECT with carrier, protocol, and compression

2 = CONNECT with DCE speed

### **S42 V.32 Retrain Operation (&B*n*)**

Default = 001

0 = &B0 is selected

**1 = &B1 is selected**

2 = &B2 is selected

### **S43 Auto Fallback Character for MNP Negotiation**

0 disabled

1-127 enabled

Default 013

#### **S44 Bit-Mapped Option Status**

Default = (17h) (023d) (00010111b)

Bit 0 V.42bis status

0 disabled

**1 enabled**

Bit 1-2 V.42bis selection ("Hn")

00 "H0 is selected

01 "H is selected

10 "H2 is selected

**11 "H3 selected**

Bit 3 Reserved

Bit 4 Auto fallback/fall forward selection (%Gn)

0 %G0 is selected

**1 %G1 is selected**

Bit 5-7 Reserved

#### **S46 Automatic Sleep Timer**

0-255 Sleep delay - unit = 100 ms

Specifies the time the controller waits before going to sleep. The data pump is not affected.

0-254 = 0-25.4 s

Default value = 255 (disabled)

#### **S47 Forced Sleep Timer with Powerdown Mode in PCMCIA**

0-255 Sleep delay - unit = 100 ms

Specifies the time the controller waits before going to sleep. The data pump is not affected.

0-254 = 0-25.4 s

Default value = 255 (disabled)

#### **S48 Set Autoreliable Buffer (\Cn)**

Default = 000

**0 \C0 is selected**

1 \C1 is selected

2 \C2 is selected

#### **S49 Set Maximum Block Size**

Default = 255

63 = 64 bytes = \A0

127 = 128 bytes = \A1

191 = 192 bytes = \A2

**255 = 256 bytes = \A3**

#### **S50 FAX/Data Mode Selection**

Default = 000

**0 Data mode**

1 FAX mode

### S51 Data/FAX DTE Flow Control Selection

Default = 003

Bit 0-2 (&K*n*, \Q*n*)

000 &K0, \Q0 are selected

001 &K1, \Q1 are selected

010 &K2, \Q2 are selected

**011 &K3, \Q3 are selected**

Bit 3 Reserved

Bit 4 XON/XOFF flow control (\G*n*)

**0 \G0 is selected**

1 \G1 is selected

Bit 5 DTE/DCE rate (\J*n*)

**0 \J0 is selected**

1 \J1 is selected

Bit 6, 7 XON/XOFF pass-through control (\X*n*)

**00 \X0 is selected**

01 \X1 is selected

### S52 Break Control Option

Reflects the &K*n* value.

Range: 0-5

Default: 5

### S53 Modem Operating Mode (\N*n*)

Default = 003

0 \N0 is selected

1 \N1 is selected

2 \N2 is selected

**3 \N3 is selected**

4 \N4 is selected

### S54 Bit-Mapped Option Status

Default = 000

Bit	Meaning
-----	---------

<b>0</b>	<b>B2 is selected</b>
----------	-----------------------

1	B3 is selected
---	----------------

2-6	Reserved
-----	----------

<b>7</b>	<b>0 \V0 is selected</b>
----------	--------------------------

1	\V1 is selected
---	-----------------

### S57 V.42bis Dictionary Size (see AT"N)

**Default = 002**

Range: 0-2

0 512 bytes

1 1024 bytes

**2 1536 bytes**

### **S58 BTLZ String Length**

**Default = 032**

Range: 6-64 bytes

### **S59 Bit-Mapped MNP Options**

**Default = 001**

Bit 0    *MNP5* status (%*Cn*)

0    %**C0** is selected

1    %**C1** is selected

### **S62 DTE Rate Status**

**Default = 018**

- 0    300 bits/s
- 1    600 bits/s
- 2    1200 bits/s
- 3    2400 bits/s
- 4    4800 bits/s
- 5    7200 bits/s
- 6    9600 bits/s
- 7    12000 bits/s
- 8    14400 bits/s
- 9    16800 bits/s
- 10   19200 bits/s
- 11   21600 bits/s
- 12   24000 bits/s
- 13   26400 bits/s
- 14   28800 bits/s
- 15   31200 bits/s
- 16   33600 bits/s
- 17   38400 bits/s
- 18   57600 bits/s**
- 19   115200 bits/s

### **S65 Round Trip Delay**

Units: 100 ms

## **S72 DTE Speed Select During Data Transfer**

**Default = 000**

### **0 last autobaud speed**

- 1 300 bits/s
- 2 600 bits/s
- 3 1200 bits/s
- 4 2400 bits/s
- 5 4800 bits/s
- 6 7200 bits/s
- 7 9600 bits/s
- 8 12000 bits/s
- 9 14400 bits/s
- 10 16800 bits/s
- 11 19200 bits/s
- 12 21600 bits/s
- 13 24000 bits/s
- 14 26400 bits/s
- 15 28800 bits/s
- 16 31200 bits/s
- 17 33600 bits/s
- 18 38400 bits/s
- 19 57600 bits/s
- 20 115200 bits/s



# Result Codes

The modem connect message is controlled by ATQ, ATV, ATW, ATX, and ATV.

## Display Format Options

If ATQ1 is selected, there will be no connect message at all. The following description is true only if ATQ0 is selected.

If ATX0 is selected, "CONNECT" or "1" will be used for all DTE and DCE speed regardless of ATW and ATV options.

The following description is true only if ATX0 is NOT selected.

If ATV0 is selected, all the messages will be displayed in numeric format, such as "0" for "OK", "1" for "CONNECT", etc.

If ATV1 is selected, all the messages will be displayed in verbose format, such as "OK", "CONNECT 14400", "CONNECT 14400/LAP-M", etc.

## Extended Message Options

ATV1 affects only ATW0 and ATW2 commands.

If ATW0, ATV1, and ATV0 are selected and the DTE rate is 57600 bits/s, then “CONNECT 57600” will be displayed regardless of protocol.

If ATW0, ATV1, and ATV1, are selected and the DTE rate is 57600 bits/s, then:

- a. “CONNECT 57600/NONE” will be displayed for V.14 connection
- b. “CONNECT 57600/MNP” will be displayed for *MNP* connection
- c. “CONNECT 57600/LAP-M” will be displayed for LAPM connection

If ATW2, ATV1, and ATV0 are selected and the DCE rate is 14400 bits/s, then “CONNECT 14400” will be displayed regardless of protocol.

If ATW2, ATV1, and ATV1 are selected and the DCE rate is 14400 bits/s, then:

- a. “CONNECT 14400/NONE” will be displayed for V.14 connection
- b. “CONNECT 14400/MNP” will be displayed for *MNP* connection
- c. “CONNECT 14400/LAP-M” will be displayed for LAPM connection

If ATV0 is selected, then a set of numeric code will be displayed. Please refer to the table for further information.

If ATW1 and ATV1 is selected, then the display will be as follows:

- a. nonprotocol mode  
CARRIER 14400 for line speed  
PROTOCOL: NONE for protocol  
COMPRESSION: NONE for data compression  
CONNECT 57600 for DTE speed
- b. *MNP* mode, with *MNP* 3, 4 protocol and *MNP*5 data compression  
CARRIER 14400 for line speed  
PROTOCOL: *MNP* 3,4 for protocol  
COMPRESSION: CLASS 5 for data compression  
CONNECT 57600 for DTE speed
- c. LAPM mode, with V.42bis data compression  
CARRIER 14400 for line speed  
PROTOCOL: LAP-M for protocol  
COMPRESSION: V.42bis for data compression  
CONNECT 57600 for DTE speed

### 0 OK

The OK code is returned by the modem to acknowledge execution of a command line.

### 1 CONNECT

The modem will send this result code upon connection when:

1. The line speed is 300 bits/s, and the modem has been instructed to report the line speed to the DTE upon connecting, or
2. The DTE speed is 300 bits/s, and the modem has been instructed to report the DTE speed to the DTE upon connecting, or
3. The range of result code responses is restricted by the X command such that no speed reporting is allowed.

## **2 RING**

The modem sends this result code when incoming ringing is detected on the line.

## **3 NO CARRIER**

The modem sends this result code when attempting to establish a call if:

1. Ringback is detected and later ceases but no carrier is detected within the period of time determined by register **S7**, or
2. No ringback is detected within the period of time determined by register **S7**.

This result code is also used when the modem autodisconnects due to loss of carrier.

Under **X0**, if busy tone detection is enforced, this result code is used as a response to the detection of busy or circuit busy. Under **X0**, if dial tone detection is enforced or selected, this result code is used to indicate that dial tone has not been detected.

## **4 ERROR**

The modem returns this result code if the command line contains a syntax error or it is unable to execute a command contained in the command line. It is issued if a command does not exist or if the parameter supplied is outside the permitted range.

## **6 NO DIAL TONE**

For **X2** and **X4**, the modem sends this result code if it has been instructed to wait for dial tone during dialing but none is received.

## **7 BUSY**

For **X3** and **X4**, if busy tone detection is enforced, the modem sends this result code when attempting to originate a call if the busy (engaged) signal is detected on the line.

## **8 NO ANSWER**

The modem sends this result code when attempting to originate a call if the **@** dial modifier is used and the modem does not detect silence before the expiration of the timer **S7**.

5, 10-15, and 24-33    Connect Rate (see Table 6, page 10 for rate)

For **X1**, **X2**, **X3**, and **X4**, the modem sends this result code when:

1. The line speed is the speed following the connect and the modem has been instructed to report the line speed to the DTE upon connecting by the **W2** command.
2. The DTE speed is 2400 bits/s and the modem has been instructed to report the DTE speed to the DTE upon connecting using the **W0** command.

## Negotiation Progress Messages

### 40 CARRIER 300

The modem returns this result code when either a V.21 or Bell 103 carrier has been detected on the line, and carrier reporting has been enabled. (See W1.)

### 42 CARRIER 75/1200

The modem sends this result code when the V.23 backward channel carrier has been detected on the line, and carrier reporting has been enabled. (See X4.)

### 43 CARRIER 1200/75

The modem sends this result code when the V.23 forward channel carrier has been detected on the line, and carrier reporting has been enabled.

### 46 CARRIER 1200

The modem sends this result code when either the high or low channel carrier in either V.22 or Bell 212 mode has been detected on the line, and carrier reporting has been enabled.

### 47 CARRIER 2400

The modem sends this result code when either the high or low channel carrier in V.22bis or V.34 mode has been detected on the line, and carrier reporting has been enabled.

### 48 CARRIER 4800

The modem sends this result code when the channel carrier in V.32, V.32bis, or V.34 has been detected on the line, and carrier reporting has been enabled.

### 49 CARRIER 7200

The modem sends this result code when the channel carrier in V.32bis or V.34 has been detected on the line, and carrier reporting has been enabled.

### 50 CARRIER 9600

The modem sends this result code when the channel carrier in V.32, V.32bis, or V.34 mode has been detected on the line, and carrier reporting has been enabled.

### 51 CARRIER 12000

The modem sends this result code when the channel carrier in V.32bis or V.34 mode has been detected on the line, and carrier reporting has been enabled.

### 52 CARRIER 14400

The modem sends this result code when the channel carrier in V.32bis or V.34 mode has been detected on the line, and carrier reporting has been enabled.

### 53 CARRIER 16800

The modem sends this result code when the channel carrier in V.32terbo or V.34 mode has been detected on the line, and carrier reporting has been enabled.

### 54 CARRIER 19200

The modem sends this result code when the channel carrier in V.32terbo or V.34 mode has been detected on the line, and carrier reporting has been enabled.

### 55 CARRIER 21600

The modem sends this result code when the channel carrier in V.34 mode has been detected on the line, and carrier reporting has been enabled.

## **56 CARRIER 24000**

The modem sends this result code when the channel carrier in V.34 mode has been detected on the line, and carrier reporting has been enabled.

## **57 CARRIER 26400**

The modem sends this result code when the channel carrier in V.34 mode has been detected on the line, and carrier reporting has been enabled.

## **58 CARRIER 28800**

The modem sends this result code when the channel carrier in V.34 mode has been detected on the line, and carrier reporting has been enabled.

## **59 CARRIER 31200**

The modem sends this result code when the channel carrier in V.34 mode has been detected on the line, and carrier reporting has been enabled.

## **60 CARRIER 33600**

The modem sends this result code when the channel carrier in V.34 mode has been detected on the line, and carrier reporting has been enabled.

## **66 COMPRESSION: CLASS 5**

This message is sent to the DTE when the modem has connected in *MNP* Class 5, and COMPRESSION message reporting has been enabled.

## **67 COMPRESSION: V.42bis**

This message is sent to the DTE when the modem has connected in V.42bis data compression, and COMPRESSION message reporting has been enabled.

## **69 COMPRESSION: NONE**

This message is sent to the DTE when the modem has connected without data compression, and COMPRESSION message reporting has been enabled.

## **70 PROTOCOL: NONE**

This message is sent to the DTE when the modem has connected without any form of error correction, and the PROTOCOL message reporting has been enabled.

## **77 PROTOCOL: LAP-M**

This message is sent to the DTE when the modem has connected in the V.42 LAPM mode of error correction, and PROTOCOL message reporting has been enabled.

## **80 PROTOCOL: MNP**

This message is sent to the DTE when the modem has connected in the *MNP* mode of error correction, and PROTOCOL message reporting has been enabled.

## **81 PROTOCOL: MNP 2**

This message is sent to the DTE when the modem has connected in the *MNP* mode of error correction, and PROTOCOL message reporting has been enabled.

## **82 PROTOCOL: MNP 3**

This message is sent to the DTE when the modem has connected in the *MNP* mode of error correction, and PROTOCOL message reporting has been enabled.

**83 PROTOCOL: *MNP 2, 4***

This message is sent to the DTE when the modem has connected in the *MNP* mode of error correction, and PROTOCOL message reporting has been enabled.

**84 PROTOCOL: *MNP 3, 4***

This message is sent to the DTE when the modem has connected in the *MNP* mode of error correction, and PROTOCOL message reporting has been enabled.

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